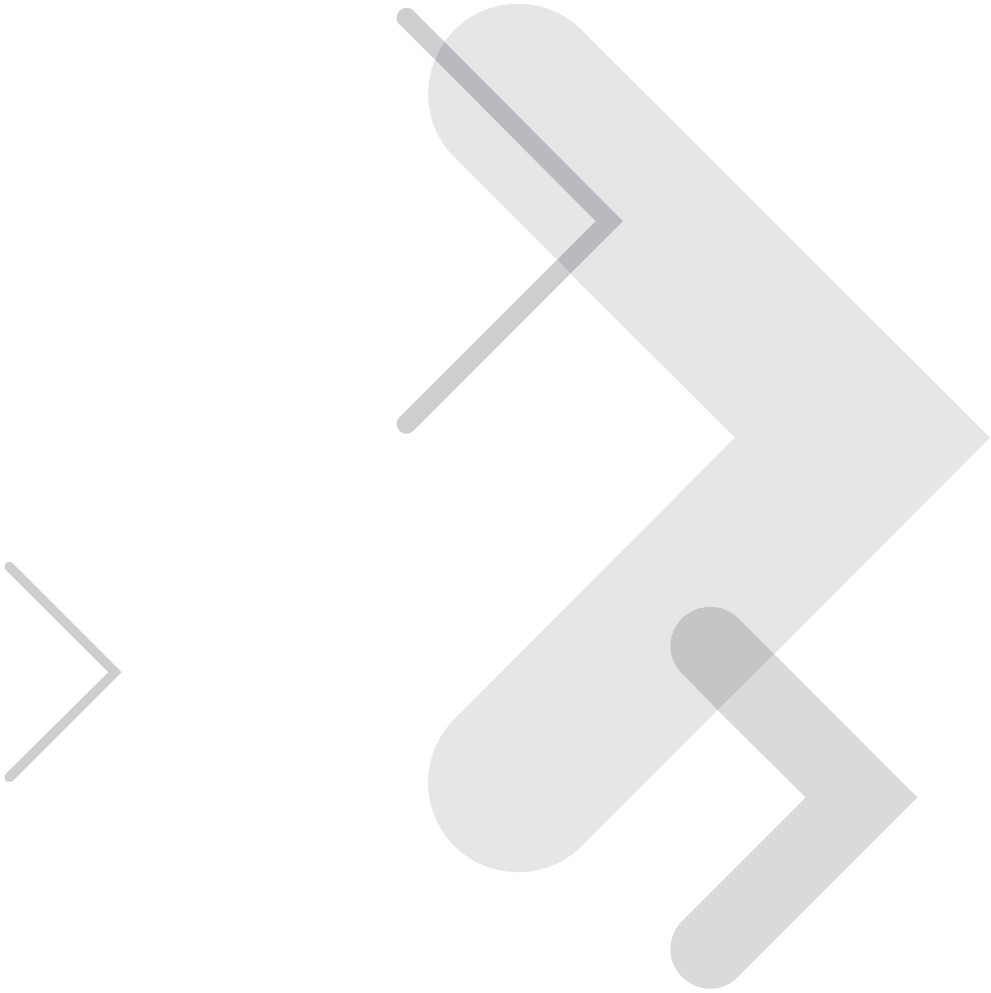
Canopy® Software Release 9.5 Release Notes

Issue 2

October 2009



Notices

See important regulatory and legal notices in Section 10 on Page 58.

Trademarks, Product Names, and Service Names

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Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 APPLICABILITY

Release 9.5 is a general release applicable to

Radio Type	PMP (Point-to-MultiPoint)	PTP (Point-To-Point)
FSK *	PMP 100 Series	PTP 100 Series
4.9-GHz OFDM	PMP 49400	PTP 49200
5.4-GHz OFDM	PMP 54400	PTP 54200

* FSK frequencies: 900 MHz, 2.4, 5.1, 5.2, 5.4, 5.7, 5.9, 6.050 MHz

Within the United States and its territories the following radios require this release:

- PMP 100 Series FSK Access Points (APs) in the 5.2-, 5.4-, and 5.7- GHz bands of hardware series P10 or higher
- PTP 100 Series FSK Backhauls (BHs) in the 5.2-, 5.4-, and 5.7- GHz bands of hardware series P10 or higher
- PMP 400 Series OFDM APs in the 5.4-GHz band
- PTP 200 Series OFDM BHs 5.4-GHz band

This release includes changes to the US Region Code in response to publications recently issued by the US Federal Communications Commission (FCC) providing interpretation of certain Part 15 rules as well as addresses concerns about possible interference caused by Part 15 devices with Terminal Doppler Weather Radar (TDWR) systems. As described in Section 2.3 on page 14, Release 9.5 provides a mechanism for operators to ensure that their systems are compliant with FCC guidance. It is important that Canopy Release 9.5 be deployed promptly within the United States and its territories to insure compliance with the new FCC guidelines and to help prevent the potential for interference with TDWR systems used to obtain weather information for airports.

It is recommended to upgrade all PMP 400 OFDM APs and SM and PTP 200 OFDM BHs to this release to avoid a potential radio communication issue. See Item # 11590 in Table 6 on page 33 for additional information.

For details on applicability, see section 7.1.1 and Table 11: Radios upgradeable to Release 9.5 on page 46.

1.2 RELEASE HIGHLIGHTS

Highlights of Canopy Release 9.5 include

Table 1: Release 9.5 highlights

Highlight	Brief Description
Changes for US Region Code and TDWR radar band to support compliance with US FCC guidance	A 5.2-, 5.4-, or 5.7-GHz P10 or higher AP or BH with a **Region Code** set to **United States** and upgraded to Release 9.5 will no longer be configurable to another **Region Code** by installers or end users. 5.4-GHz radios with a **United States Region Code** will not transmit in the Terminal Doppler Weather Radar (TDWR) band of 5600 to 5650 MHz. **To ensure systems are compliant with FCC guidance, operators within the United States and its territories are required to upgrade the modules listed above to Release 9.5.** For important information on these enhancements, see Section 2.3 on page 14.
Avoid potential issue with PMP 400 and PTP 200 OFDM modules	Due to an issue in previous releases, PMP 400 and PTP 200 OFDM modules have a potential to drop the radio communication link (appear to fail) as they age. Release 9.5 resolves the issue. **Operators should update all PMP 400 and PTP 200 OFDM modules to Release 9.5 so as to avoid potential communication issues.** See Item # 11590 in Table 6 on page 33 for additional information.
AP DHCP Relay/Option 82	AP acts as a DHCP relay for SMs and CPE underneath it.
Color Code Priority on SM	On the SM, multiple color codes (up to 10 per SM) and priorities (3) allow more control of which AP an SM will register to during normal and off-normal conditions.
AP/SM Pre-Shared Key Authentication	AP acts as authentication server to its SMs via a 32 character hexadecimal user-configurable authentication key.
900-MHz Limited AP	900-MHz Limited AP supports up to 10 SMs. A Limited AP can be upgraded to an Advantage AP via an orderable license key.

For detailed information, see

- Table 3: Release 9.5 enhancements on Page 12
- Table 6: Issues resolved in Release on Page 33
- Table 7: Known open issues on Page 38

Either CNUT 3.20 or Prizm 3.2 is recommended for upgrading modules to Release 9.5. For details, see Upgrade Tool Options on Page 47.

1.3 ABBREVIATIONS

The following abbreviations may be used in these notes:

AP	Access Point Module
BH	Backhaul Module, either timing master or timing slave
BHM	Backhaul Module – timing master
BHS	Backhaul Module – timing slave
CIR	Committed Information Rate
CNUT	Canopy Network Updater Tool
CMM	Cluster Management Module
DFS	Dynamic Frequency Selection for radar avoidance
DHCP	Dynamic Host Configuration Protocol
DHCP Relay	Relays DHCP messages between clients and servers
DL	Downlink
ETSI	European Telecommunications Standards Institute
FSK	Frequency Shift Keying
LUID	Logical Unit ID
MIB	Management Information Base
MIR	Maximum Information Rate
OFDM	Orthogonal Frequency Division Multiplexing
OID	Object Identifier for an object in a MIB
P7/P8/P9/P10/P11	Shorthand for hardware series levels
PMP	Point to Multi-Point
PTP	Point to Point
SM	Subscriber Module
TDWR	Terminal Doppler Weather Radar
UDP	User Datagram Protocol
UL	Uplink
VC	Virtual Circuit

1.4 NAMES

Table 2 maps product names to previous names, older names, and example model numbers.

Table 2: Product names

Product Name	Previous Name	Older Name	Model Number (example)
PMP 100 Series	PMP 100 and PMP 200 Series	Canopy FSK point-to-multipoint	—
CAP 120	CAP 100	Classic AP	5700AP
CAP 130	CAP 200	Advantage AP	5750AP
CSM 110	—	Lite SM	5760SM
CSM 120	CSM 100	SM	5700SM
CSM 130	CSM 200	Advantage SM	5750SM
PTP 100 Series	—	Canopy FSK BHs	—
PTP 110	—	4 Mbps BH, 2 Mbps BH	—
PTP 120	PTP 100 Lite	BH10 (7 Mbps BH)	5700BH
PTP 130	PTP 100 Full	BH20 (14 Mbps BH)	5700BH20
PMP 49400	—	Canopy 4.9-GHz OFDM PMP	—
CAP 49400	—	4.9-GHz OFDM AP	4940AP
CSM 49400	—	4.9-GHz OFDM SM	4940SM
PTP 49200	—	Canopy 4.9-GHz OFDM BH	4940BH
PMP 54400	—	Canopy 5.4-GHz OFDM PMP	—
CAP 54400	—	5.4-GHz OFDM AP	5440AP
CSM 54400	—	5.4-GHz OFDM SM	5440SM
PTP 54200	—	Canopy 5.4-GHz OFDM BH	5440BH

1.5 IDENTIFYING HARDWARE SERIES (P7, P8, P9, P10, P11)

The following methods can be used to identify the hardware series of a module:

- For modules that are running Release 8 or Release 9, look on the Home => General Status tab, under **Board Type** as shown in Figure 1.

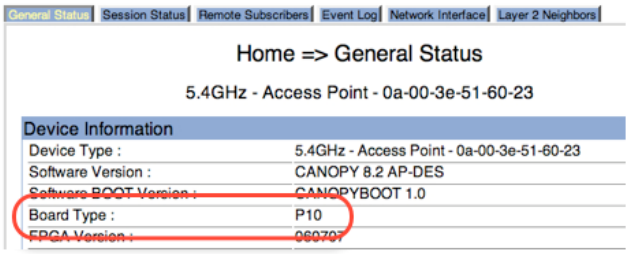


Figure 1: Board Type on modules running Release 8.

- For modules that are running Release 7.3.6, view the Configuration web page.
  - If a Scheduling option is present, as shown in Figure 2 below, then the hardware series is P9.

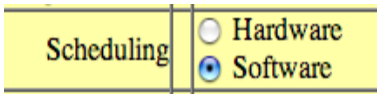


Figure 2: Scheduling option – if viewable, indicates this is a P9 Board.

  - If no Scheduling option is present, then the series is either P7 or P8.
- For modules running any release, open a **`telnet`** interface to the module and enter **`version`**. The hardware series is shown under `Hardware Platform` as `7`, `8`, `9`, `10`, or `11`.

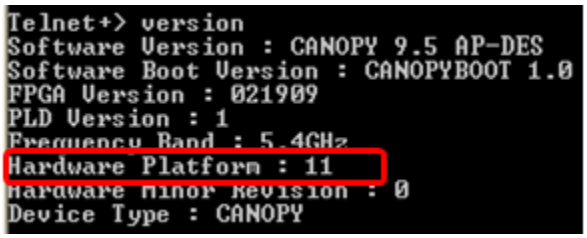


Figure 3: Telnet – Version showing hardware platform.

1.6 DOCUMENT CHANGE HISTORY

Issue 1a	First Issue
Issue 2	Addition to Section 4: Known open issue: SM – DNS below a NATed SM

1.7 FEEDBACK ON DOCUMENTATION

Is this document accurate, complete, and clear? How can it be improved? Please send your feedback on Canopy documentation to technical-documentation@canopywireless.com.

1.8 TECHNICAL SUPPORT

Tip! Do not clear the Event Log after you encounter issues. It may be useful to Technical Support, if you need to escalate the issue.

Here is the escalation path for resolution of a problem:

1. Check documentation:
   - this document
   - Canopy System Release 8 Users Guide, available at http://motorola.wirelessbroadbandsupport.com/software.
2. Consider checking the Community Forum and Knowledge Base at http://motorola.wirelessbroadbandsupport.com/support/community.
3. Escalate the problem to your Canopy supplier or reseller.
4. Escalate the problem to Canopy Technical Support or other designated Tier 3 technical support:

U.S. and Canada	**Email:** technical-support@canopywireless.com 1-866-961-9288	
Latin and Central America	**Email:** technical-support@canopywireless.com	
	Argentina	0800-666-2789
	Brazil	0800-891-4360
	Columbia	01-800-912-0557
	Mexico	001-800-942-7721
	Peru	0800-70-086
	All other countries	+420 533 336 946
Europe, Middle East, and Africa	**Email:** essc@motorola.com	
	Denmark	043682114
	France	0157323434
	Germany	06950070204
	Italy	0291483230
	Lithuania	880 030 828
	Netherlands	0202061404
	Norway	24159815
	Portugal	0217616160
	Spain	0912754787
	Russia	810 800 228 41044
	Saudi Arabia	800 844 5345
	South Africa	0800981900
	United Kingdom	0203 0277499
Asia Pacific	**Email:** WiBBsupport.apac@motorola.com +6048503854 (9am - 5pm Malaysia Time) +420 533 336 946 (outside hours)	

When you send e-mail or call, please include, as appropriate, software release on each module, IP addresses, MAC addresses, and features enabled, like NAT, VLAN, high priority channel, or CIR. You may be asked to run the Support Tool on CNUT or Prizm to provide a complete network picture.

2 Features and Enhancements

The following sections list features and enhancements for Release 9.5.

2.1 RELEASE 9.5 ENHANCEMENTS

Release 9.5 adds the enhancements listed in Table 3.

Table 3: Release 9.5 enhancements

Enhancement Type / Section	Enhancement	Summary
Regulatory 2.3	Changes for 5-GHz Radios set to United States Region Code	A 5.2-, 5.4-, or 5.7-GHz P10 or higher AP or BH with a **Region Code** set to **United States** and upgraded to Release 9.5 will no longer be configurable to another **Region Code** by installers or end users. 5.4-GHz radios with a **United States Region Code** will not transmit in the Terminal Doppler Weather Radar (TDWR) band of 5600 to 5650 MHz.
Network 2.4	AP – DHCP Relay/Option 82 Two Configurations: 1) Full Relay Operation 2) Only Insert Option 82	Enabling DHCP Relay at the AP will allow the DHCP server to know which SM was used to obtain an address at a given time. It also allows the DHCP server to be located anywhere on the network since the relay will take broadcast DHCP packets and send them to a Unicast server in unicast mode. This way the DHCP requests and replies can be routed like any other UDP packet. An alternative option is to select Only Insert Option 82 which leaves the DHCP request on its broadcast domain as opposed to DHCP Full Relay Operation which will turn it into a unicast packet.
Network 2.5	SM/BH – Large VC Data Queue	SMs or BHs that are experiencing packet loss in the uplink due to bursting IP traffic (for example, video surveillance applications) will benefit from enabling the Large VC Data Queue.
Network 2.6	SNMP Updates for SM Registration Failures	SNMP registration failure table and status traps.
Security 2.7	AP/SM Pre-Shared Key Authentication	Configurable AP authentication key mechanism to authenticate SMs using a user-configurable pre-shared authentication key. In earlier releases, authentication required the use of a Prizm Bandwidth Authentication Server.
Security 2.8	Ability to Hide Site Info from Guest Users on SM	SM site information can be hidden from a guest user and only shown if a user logs in as an administrator.
Authentication 2.9	Increasing Number of Prizm Authentication Servers on AP	Two additional authentication servers have been added, for a total of five, to the AP's Configuration =>Security web page.
Authentication 2.10	PPPoE CHAP Authentication Support	The PPPoE authentication type selection has been changed from PAP only to CHAP/PAP.

Enhancement Type / Section	Enhancement	Summary
Network Redundancy 2.11	Color Code Priority on SM	SMs have a total of ten configurable color codes which can be tagged as Primary, Secondary or Tertiary. In earlier releases, there was one primary color code.
Usability 2.12	GPS Coordinates Stored in AP, SM and BH	AP, SM or BH contain input fields for Latitude, Longitude and Height in the Configuration => General web page.
Usability 2.13	Configuration to Hide Idle Subscribers on AP	AP configurable option to hide idle subscribers from the Home => Session Status web page.
Usability 2.14	Quick Login on AP, SM and BH	Login is now directly on the left sidebar on the main web splash page eliminating the extra step to click login button.
Usability 2.15	Obsolete Unused OIDs	Six OIDs that are no longer used are no longer in the MIBs.
Usability 2.16	Only Allowing AP to Register SMs that are on at least R9.5	AP can reject SMs upon registration if they are running a software release earlier than R9.5. The option is configurable in the AP Configuration =>Radio tab. Default is Disable.
Usability 2.17	Clear Statistics	AP, SM or BH statistics can be cleared for each statistics tab. In earlier releases statistics were only cleared upon reboot.
Usability 2.18	Pop-up Tool Tips	Several radio web pages have roll over tool tip pop-ups to explain specific radio features.
Product 2.19	900-MHz Limited AP	900-MHz Limited AP (connectorized) supports up to 10 registered 900-MHz SMs. A feature key is orderable to upgrade a 900-MHz Limited AP to an Advantage AP.

2.2 PERFORMANCE – PACKETS PER SECOND

Packet per Second (PPS) performance for Release 9.5 is the same as for recent releases. Benchmark values are shown in Table 4.

Table 4: Packet per Second (pps) performance

Product	Hardware series	
	P11 or P10	P9
PMP 5x100 and PMP 24100	6200	3500
PMP 5x100 and PMP 24100 with VLAN	5200	3200
PMP 09100 (900 MHz)	4600	3600
PTP 5x100 and PTP 24100	6200	3200[1]

Product	Hardware series	
	P11 or P10	P9
PMP 54400	6800	—
PTP 54200	4800	—
PMP 49400	6300	—
PMP 49400 with VLAN	5300	—
Note: No significant difference between DES and AES 1: Links with a P9 module on one end and a P10 or P11 module on the other perform between 3200 and 3500 pps		

Section 9, Performance Benchmarking Process, on page 55 describes the benchmarking process used to measure packets per second and discusses the meaning and limitations of the benchmark.

2.3 5-GHZ RADIOS SET TO UNITED STATES REGION CODE

On June 8, 2009, the FCC posted on its website an interpretation (KDB 594280) of the Part 15 rules. This interpretation stated that neither end users nor professional installers can have access to settings (such as region/country codes for frequency bands, DFS profiles, etc.) which could allow a radio to be configured to operate in a manner other than that which was specified in the FCC equipment authorization grant. Canopy Release 9.5 guards against operators inadvertently selecting a non-FCC authorized configuration.

Canopy Release 9.5 also responds to FCC concerns expressed to the wireless broadband industry about possible interference caused by Part 15 devices with TDWR systems. Note that Section 15.5(b) of the FCC rules state that Part 15 devices are not permitted to cause harmful interference.

Motorola Canopy equipment employs advanced radar detection algorithms which can discriminate between actual radar signatures and other RF signals. This approach significantly reduces false radar detections and the resultant service interruptions, giving operators using Motorola Canopy equipment an advantage over competitors using equipment which only employs less-sophisticated energy-detection-based approaches.

Although Motorola Canopy equipment is fully compliant with current FCC testing requirements, these requirements may not adequately represent all TDWR profiles and it is possible that some TDWR signals could go undetected. As noted in the Canopy DFS Deployment Guide[1], Motorola recommends procedures to help avoid any potential interference.

If new radios are received containing a release prior to 9.5, please follow the upgrade process as described in Section 7.

[1] Technical Brief: Canopy Dynamic Frequency Selection Deployment Guide, Version 1.0, February 2008.

2.3.1 US Region Code for US 5.x-GHz APs

A 5.2-, 5.4-, or 5.7-GHz P10 or higher AP or BH with a **Region Code** set to **United States** and upgraded to Release 9.5 will continue to be set to the **United States Region Code** and will not be configurable to another **Region Code** by installers or end users. As discussed in section 2.3, this is in response to FCC KDB 594280 and ensures that end users and professional installers will not have access to settings which could allow a radio to be configured to operate in a manner other than that which was specified in the FCC equipment authorization grant.

After upgrade, the AP or BH will display the **Region Code** on the Configuration => General page as **United States** in a gray font, and the parameter is no longer settable, as shown in Figure 4.

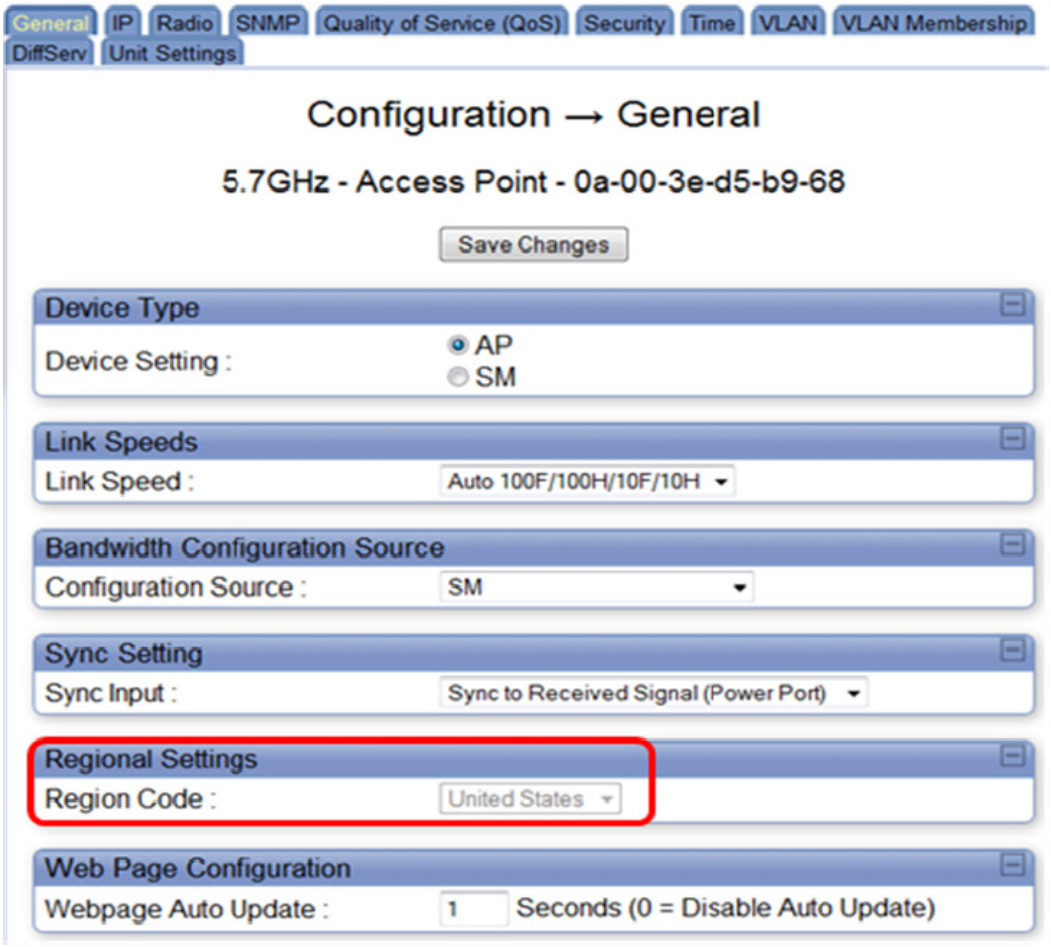


Figure 4: Configuration => General page with Region set to United States

2.3.2 US 5.4-GHz Radios and the TDWR Band

To prevent co-channel operation with Terminal Doppler Weather Radar (TDWR) systems, P10 and P11 5.4-GHz APs and BHMs configured with a **Region Code** of **United States** running Release 9.5 will not use or allow configuration of the center channel frequencies shown in table 5.

Table 5: Center channels unavailable

Product Family	Products	Center Channel Frequencies not available
FSK	CAP 100 (AP) PTP 100 (BH)	5590 through 5660 MHz (on 5-MHz increments) not available
OFDM	CAP 54400 (AP) PTP 54200 (BH)	5600 through 5650 MHz (on 5-MHz increments) not available

This applies to the **Radio Frequency Carrier,** as well as the **Alternate Frequency Carrier 1** and **Alternate Frequency Carrier 2** on an AP's or BHM's Configuration => Radio page. As discussed in section 2.3, avoiding the TDWR band addresses FCC concerns about possible interference caused by Part 15 devices with TDWR.

Operators with 5.4-GHz APs or BHMs set to a **Region Code** of **United States** are well-served to ensure they are not using any of the unavailable channels before upgrading. Operators may need to perform channel planning and coordinated change of the transmitting channel on APs or BHMs *before* the upgrade.

CAUTION!

Before upgrading a P10 or P11 5.4-GHz ***FSK*** AP or BHM with a **Region Code** of **United States** to Release 9.5, ensure that it is not configured with a center channel of **5590 through 5660 MHz**.

Before upgrading a 5.4-GHz ***OFDM*** AP or BHM with a **Region Code** of **United States** to Release 9.5, ensure that it is not configured with a center channel of **5600 through 5650 MHz**.

If an affected AP or BHM is inadvertently left set to one of these center channels before upgrading, after the upgrade it will not have an operating **Radio Frequency Carrier** configured, will not transmit, and there will be no link or service to SMs or a BHS. To recover after the upgrade, configure the **Radio Frequency Carrier** of the AP or the BHM to an available channel – one displayed on the AP's or BHM's Configuration => Radio page.

Similarly, if the **Alternate Frequency Carrier 1** or **Alternate Frequency Carrier 2** is inadvertently left set to one of these center channels**,** the alternate frequencies will not be available in the case of a DFS event.

The **Custom Frequency Scan List** on SMs and BHSs set to a **Region Code** of **United States** is not affected. Since the center channel frequencies listed in Table 5 will not be used (the AP or BHM won't be transmitting on them) operators may want to disable scanning of these frequencies by the SMs and BHSs to reduce scan time.

2.4 AP - DHCP RELAY/OPTION 82

The AP can now act as a DHCP relay for SMs and CPEs underneath it. The AP will make use of the DHCP Option 82 (DHCP Relay Agent Information) from RFC 3046 when performing relay functions. In this RFC, there are two sub options defined for DHCP Relay Agents to use to pass useful information along to the DHCP server to identify from where the DHCP request is coming. The sub options defined are used as follows:

1 – Circuit ID – This will contain the MAC address of the AP acting as the DHCP relay.
2 – Remote ID – This will contain the MAC address of the SM from or through which the DHCP request was generated.

Also, in order to accommodate setting up pools or classes for different VLANs, the Option 82 field will also include information to tell the server what VLAN the client is on. This Option 82 sub option is adapted from the Vendor-Specific Information Sub-option in RFC 4243. This sub option for Option 82 has the following format:

	Code	Length	Enterprise Number	Enterprise Data Length	Code	Length	Code	Length	VID
	1 byte	1 byte	4 bytes	1 byte	1byte	1byte	1byte	1byte	2bytes
Hex	0x9	0xb	0x000000a1	0x06	0x13	0x04	0x01	0x02	0xXXXX
Dec	9	11	161	6	19	4	1	2	variable

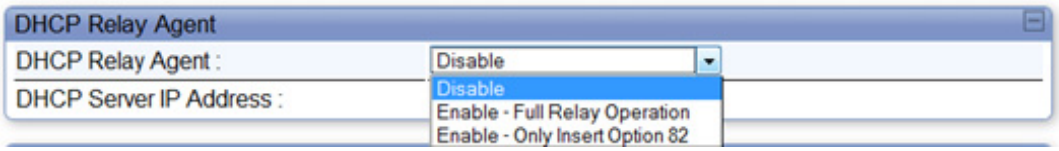


Figure 5: DHCP Relay Agent via Configuration => General on AP.

Configuring the DHCP Full Relay Operation will take broadcast DHCP packets and send them to a Unicast server in unicast mode. This way the DHCP requests and replies can be routed like any other UDP packet. A second configuration is to select Only Insert Option 82 which leaves the DHCP request on its broadcast domain as opposed to DHCP Full Relay Operation which will turn it into a unicast packet.

2.5 SM/BH – LARGE VC DATA QUEUE

Certain applications such as video Surveillance cameras operate by sending bursts of IP traffic upstream. Some systems will send short bursts of packets at over 50 Mbps and then be idle for some period of time and then send another burst of data.

In order for the RF interface of a radio to accommodate these bursts of traffic, there is now an configurable parameter on SM radios as well as BH Master and Slave radios to operate with a large input queue at the radio's data VC. This large queue allows packets which arrive at a rate greater than the radio link capacity to be stored in this deep queue until the radio is ready to transmit them. The queue size has been optimized to allow large packets to be stored just long enough so that there is always data available to be transmitted, but not large enough to cause packets to sit in a queue for a second or more.

Configuration of this parameter is shown on the Configuration => Radio web page on the SM, BHM and BHS. Operators should enable Large VC data Q on the BHM for downlink traffic or enable it on the BHS for uplink traffic.

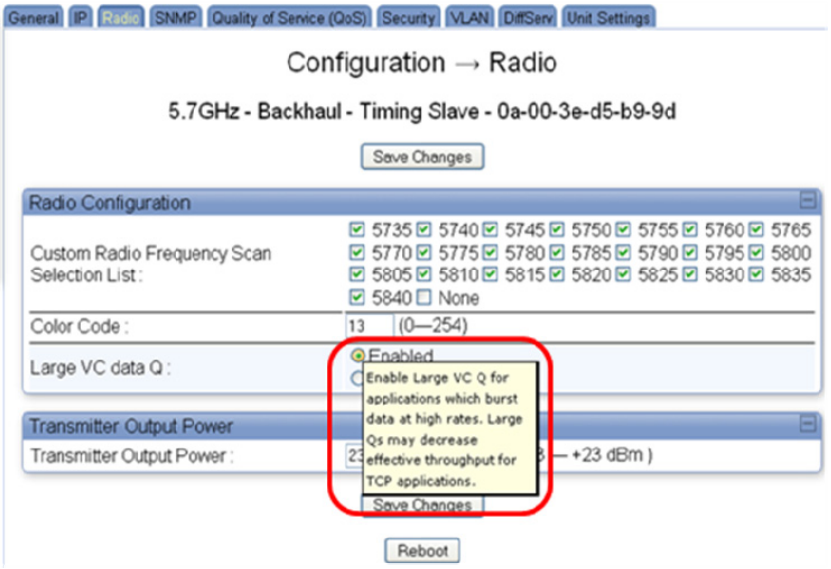


Figure 6: Enable Large VC data Q via Configuration => Radio on SM, BHM and BHS.

If an operator is experiencing packet loss in the uplink due to bursting IP traffic and the overall traffic rate is less than or equal to the uplink capacity of the radio system, then the large VC data Q should be enabled.

For example, a PTP 20 Mbps BH has a video camera connected to the BH Slave (BHS) uplink. To check if packets are being lost at the BHS RF interface the operator should check the "outdiscards Count" at the Statistics->Radio page of the BHS. If this count is incrementing, then packets are being lost at the RF interface of the BHS and the Large VC data Q should be enabled. In the figure below, the outdiscards Count shows 455 discard events since the counter was reset, indicating that probably system performance would be improved by the Large VC data Q.

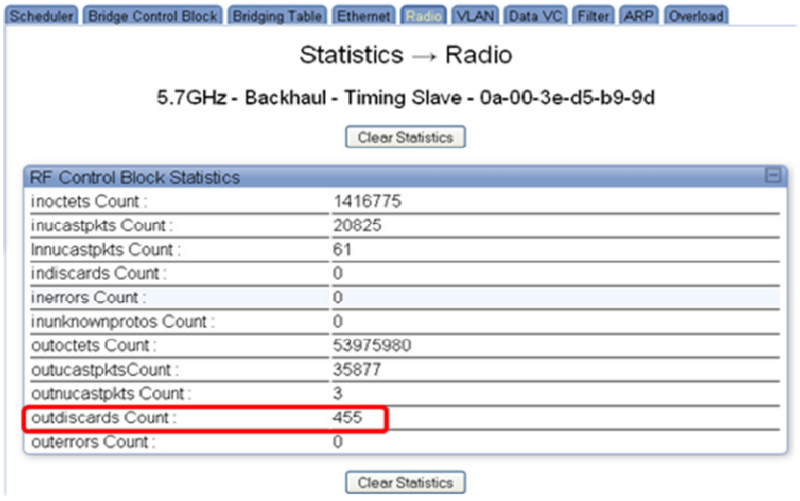


Figure 7: outdiscard Count via Statistics => Radio on SM, BHM and BHS.

The large VC data Q option can be enabled via the Configuration => Radio page on SMs, BH Masters, and BH Slaves. It is not available for APs.

2.6 SNMP UPDATES FOR SM REGISTRATION FAILURES

A new register trap was added for when an SM receives a registration grant failure. The OID is .1.3.6.1.4.1.161.19.3.1.5.1.3 (whispRegFailure). This trap is contained in the existing wispApsRegEvent group in the AP MIBs. As with the existing events in this group, this event can be enabled and disabled by the existing OID .1.3.6.1.4.1.161.19.3.1.1.28 (regTrap). Included in this trap is the ESN (MAC) address of the failed SM, failed reason Integer Object, and a text description of the reason for the failure (.1.3.6.1.4.1.161.19.3.1.8.1.5). The failed reason Integer Object is .1.3.6.1.4.1.161.19.3.1.8.1.1, which is broken up as follows:

Name	Value	Description
Valid	0	This is valid (should never occur in a trap)
Out of Range	1	The SM is out of a valid range.
No LUIDs	2	The AP has exhausted the number of allowed LUIDs.
Re Range	3	BHM needs to re-range with the BHS.
Auth Failure	4	A failure due to authentication. This can be issued by the Authentication Server, or by the AP.
Encrypt Failure	5	A failure due to an encryption failure. This can happen when encryption is enabled and the AP detects some type of an encrypt problem (such as a key mismatch).
Power Adjustment	6	OFDM Power Adjustment needed.
No VCs	7	The AP was not able to allocated a VC for the requesting SM.
Fail VC Reserve	8	The AP was not able to reserved the specific VC need for communication to the SM.
Fail VC Active	9	The AP was not able to active the VC for the SM.
Fail VC Hi Priority Data	10	The AP was not able to open the needed VC for High Priority data to the SM.
Fail SM Limit Exceeded	11	Too many SMs had tried to register to the AP. This is only valid when the AP is keyed as a AP Lite
Only Allow Ver 9.5+	12	Occurs when the AP is configured to only allow SMs with version 9.5 or above. When a SM with software version below 9.5 tries to register, it will be rejected.

A new SNMP table was added to the AP MIBs and is displayed in the GUI. The table contains the latest 40 registration failures. The table includes the following information:

Name	OID	Description
regGrantReason	.1.3.6.1.4.1.161.19.3.1.8.1.1	See last table.
regFailESN	.1.3.6.1.4.1.161.19.3.1.8.1.2	The ESN (MAC) of the SM.
regFailTime	.1.3.6.1.4.1.161.19.3.1.8.1.3	The time (TimeTicks) that the failure occurred. This is relative from when the AP booted up.
regFailSeqNum	.1.3.6.1.4.1.161.19.3.1.8.1.4	The sequence number of the entry. This is the sequence (order) in which the event occurred. The table will wrap around when full, so the sequence number should be examine to determine the proper order (other than regFailTime).
regFailReasonText	.1.3.6.1.4.1.161.19.3.1.8.1.5	A text description of the registration failure reason in regGrantReason.

In addition to the above changes, a new status was added. This is .1.3.6.1.4.1.161.19.3.1.7.32 (regFailureCount), which is the number of Registration Failures that have occurred at the AP/BHM. This is a type of Counter32. This statistic was also added to Failure SM List Page.

2.7 AP/SM PRE-SHARED KEY AUTHENTICATION

Previously, in a PMP system, the only option for authenticating SMs was through the use of the BAM Authentication function of Prizm. Now, in Release 9.5, there is a new Authentication Mode option on the AP called “AP PreShared Key” that is an alternative to BAM Authentication to prevent unauthorized SMs from registering to an AP.

When the Authentication Mode is set to this option, the AP will act as the authentication server to its SMs and will make use of a user-configurable pre-shared authentication key. The operator enters this key on both the AP and all SMs desired to register to that AP. There is also an option of leaving the AP and SMs at their default setting of using the “Default Key”. Due to the nature of the authentication operation, if you want to set a specific authentication key, then you MUST configure the key on all of the SMs and reboot them BEFORE enabling the key and option on the AP. Otherwise, if you do the AP first, none of the SMs will be able to register.

When using the new 900-MHz Limited AP (restricted to 10 SMs), consider using different keys for different sectors to force the desired mapping of SMs to APs and avoid SMs being denied service by their AP's 10-SM limit being filled with the "wrong" SMs.

The authentication key is a 32-character hexadecimal string.

Here is the updated option on the AP GUI:

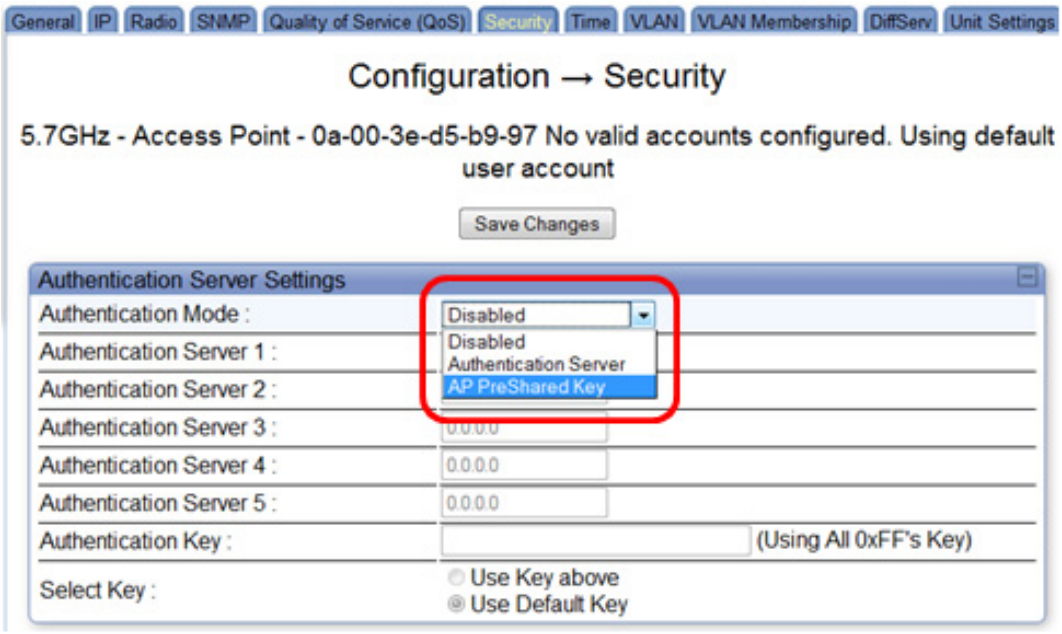


Figure 8: AP Pre-shared Key option on AP's Configuration => Security tab

Here you can see the new option in the drop-down box and the two new configuration options. When AP PreShared Key is selected, all five Authentication Server boxes will be grayed out. Similarly, when Authentication Server is selected, then Authentication Key and Select Key options all be grayed out. When Disabled is selected, all of the sub options will be grayed out.

When Select Key is set to Default Key, the Auth Key box will be grayed out and a default key using the MAC address of the SM will be used for authentication. When Use Key Above is selected, then the specified Authentication Key will be used. By default, this key is all 0xFF. Again, it is 32 hexadecimal characters in length, so that means the default configurable Authentication Key is 0xFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF. If you make a mistake when entering this key, (such as using a non-hex character – hex characters are 0-9, A-F) the key will default back to this 0xFF key.

Two OIDs of the whispAps MIB already used by BH units for this operation are now enabled for use on the AP. A new OID was added for the AP to select which key to use for authentication. These OIDs are covered in the following table.

Name	OID	Description
authMode	1.3.6.1.4.1.161.19.3.1.1.31	INTEGER 0 – Disabled 1 – AuthenticationServer 3 – AP PreShared Key This OID pre-existed, but was inaccessible on MP AP.
authKeyAp	1.3.6.1.4.1.161.19.3.1.1.32	DisplayString 32 character hexadecimal string This OID pre-existed, but was inaccessible on MP AP.
authKeyOptionAP	1.3.6.1.4.1.161.19.3.1.1.66	INTEGER 0 – use default key 1 – use key defined in authKeyAp

2.8 ABILITY TO HIDE SITE INFO FROM GUEST USERS ON SM

Operators can enable or disable site information from appearing when a user is in GUEST account mode. Configuration can be done via the GUI or via an OID.

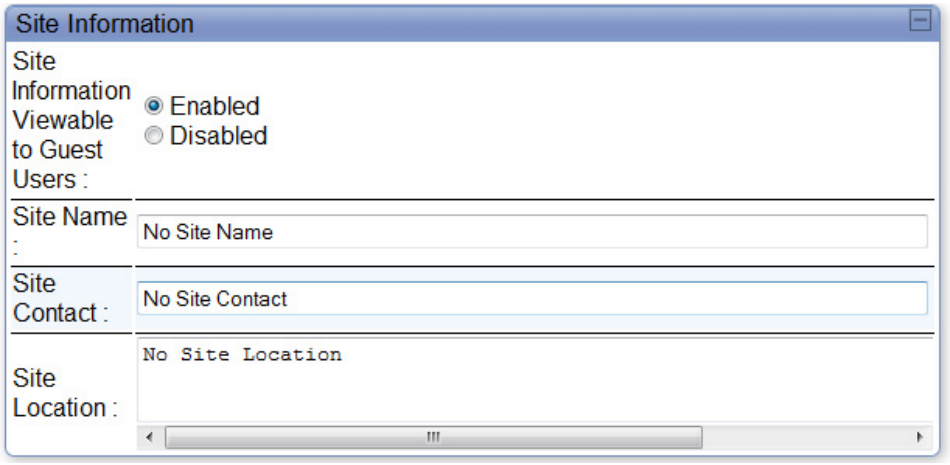


Figure 9: Configure Hide Site Information via Configuration => SMNP on SM.

The following table shows the Site Information Viewable OID's.

Name	OID	Description
siteInfoViewable	1.3.6.1.4.1.161.19.3.3.2.86	INTEGER 0 – Disabled – Do not allow guest users to see site information 1 – Enabled – Allow guest users to see site information (Default Value)

Note: Prior to release 9.5 the site information appeared in GUEST account mode.

2.9 INCREASING NUMBER OF PRIZM AUTHENTICATION SERVERS ON AP

The number of configurable Prizm bandwidth authentication server IP addresses on the AP has been increased from three to five.

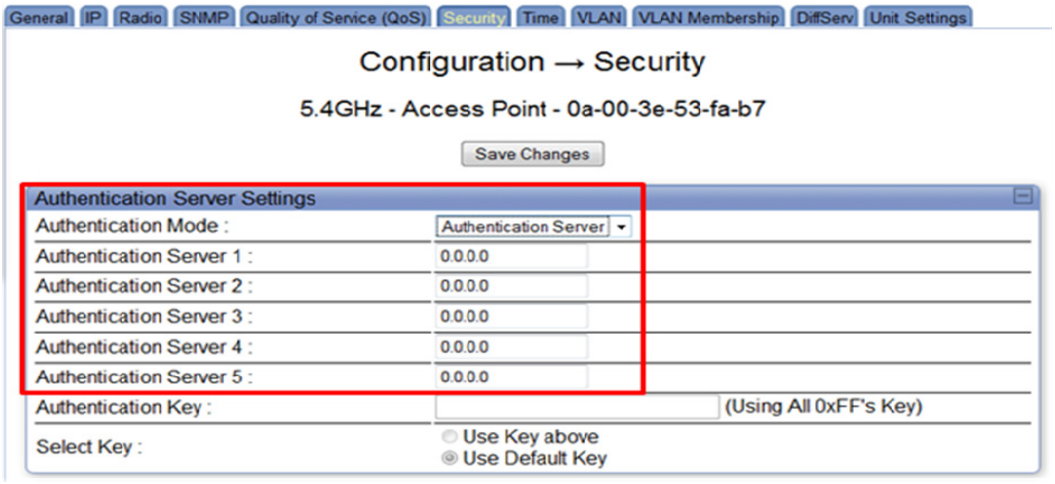


Figure 10: Configure up to 5 Prizm Authentication Servers via Configuration =>Security on AP.

This table shows the two additional authentication server OIDs.

Name	OID	Description
asIP4	1.3.6.1.4.1.161.19.3.1.1.67	IpAddress
asIP5	1.3.6.1.4.1.161.19.3.1.1.68	IpAddress

2.10 PPPOE CHAP AUTHENTICATION SUPPORT

The PPPoE authentication type selection has been changed from PAP only to CHAP/PAP on the Configuration => PPPoE web page on the SM.

The implementation uses the same password for both types of authentication and per the RFC the radio will attempt to do CHAP first and fall back to PAP if necessary. The OID for PAP password was updated to remove the PAP reference.

PPPoE CHAP OID Updates

Name	OID	Updated Description
pppoeAuthenticationType	1.3.6.1.4.1.161.19.3.2.1.78	MIB Description updated to reflect CHAP/PAP instead of just PAP as an option.
pppoeUserName	1.3.6.1.4.1.161.19.3.2.1.81	Name changed from pppoePAPUserName and MIB description updated
pppoePassword	1.3.6.1.4.1.161.19.3.2.1.82	Name changed from pppoePAPPassword and MIB description updated

2.11 COLOR CODE PRIORITY ON SM

SMs may now be configured with up to 10 color codes. These color codes can be tagged as “Primary”, Secondary”, or “Tertiary”. When the SM is scanning for APs, it will first attempt to register to an AP that matches one of the SM’s Primary color codes. Failing that, the SM will continue scanning and attempt to register to an AP that matches one of the SM’s Secondary color codes. Failing that, the SM will continue scanning and attempt to register to an AP that matches one of the SM’s Tertiary color codes. This is all done in the scanning mode of the SM and will repeat until a registration has occurred.

Color codes in the same priority group are treated equally. For example, all APs matching one of the SM’s Primary color codes are analyzed equally. Likewise, this evaluation is done for the “Secondary” and “Tertiary” priority groups in order. The analysis for selecting an AP within a priority group is based on various inputs, including signal strength and number of SMs already registered to each AP.

The first color code in the configuration (Color Code 1) is the pre-Release 9.5 color code. Thus, it is always a “Primary” Color Code for legacy reasons.

The color codes can be disabled, with the exception of the first color code.

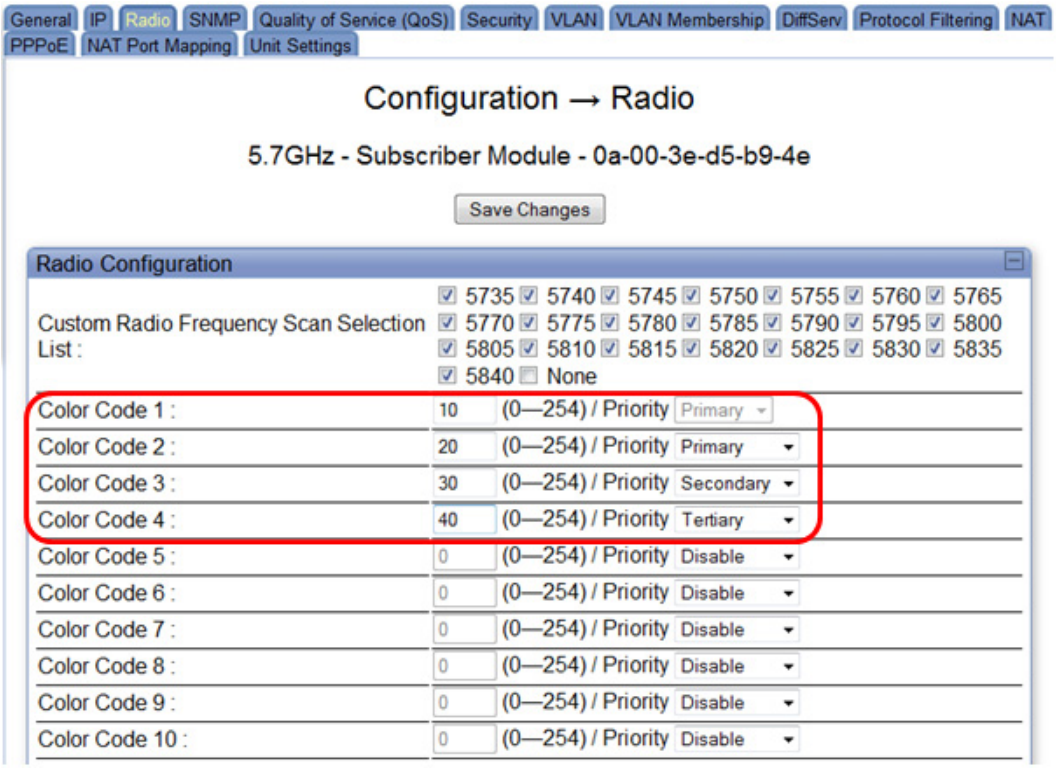


Figure 11: Configure Multiple Color Codes via Configuration => Radio on SM.

Color Codes 2 through 10 are placed in the SM MIB. The current first color code exists in the box MIB as it is used for both the AP and SM. The SM MIB updates are as follows:

Name	Value	Description
colorCode2	.1.3.6.1.4.1.161.19.3.2.1.97	Second Color Code
colorCodepriority2	.1.3.6.1.4.1.161.19.3.2.1.98	Priority for the second color code. Values are primary (1), secondary (2), tertiary (3), or disabled (0).
colorCode3	.1.3.6.1.4.1.161.19.3.2.1.99	Third Color Code
colorCodepriority3	.1.3.6.1.4.1.161.19.3.2.1.100	Priority for the third color code. (See colorCodepriority2 for values)
colorCode4	.1.3.6.1.4.1.161.19.3.2.1.101	Fourth Color Code
colorCodepriority4	.1.3.6.1.4.1.161.19.3.2.1.102	Fourth Color Code priority. (See colorCodepriority2 for values).
colorCode5	.1.3.6.1.4.1.161.19.3.2.1.103	Fifth Color Code
colorCodepriority5	.1.3.6.1.4.1.161.19.3.2.1.104	Priority for the fifth color code. (See colorCodepriority2 for values).
colorCode6	.1.3.6.1.4.1.161.19.3.2.1.105	Sixth Color Code.
colorCodepriority6	.1.3.6.1.4.1.161.19.3.2.1.106	Priority for the sixth color code. (See colorCodepriority2 for values).
colorCode7	.1.3.6.1.4.1.161.19.3.2.1.107	Seventh Color Code.
colorCodepriority7	.1.3.6.1.4.1.161.19.3.2.1.108	Priority for the seventh color code. (See colorCodepriority2 for values).
colorCode8	.1.3.6.1.4.1.161.19.3.2.1.109	Eighth Color Code.
colorCodepriority8	.1.3.6.1.4.1.161.19.3.2.1.110	Priority for the eighth color code. (See colorCodepriority2 for values).
colorCode9	.1.3.6.1.4.1.161.19.3.2.1.111	Ninth Color Code.
colorCodepriority9	.1.3.6.1.4.1.161.19.3.2.1.112	Priority for the ninth color code. (See colorCodepriority2 for values).
colorCode10	.1.3.6.1.4.1.161.19.3.2.1.113	Tenth Color Code.
colorCodepriority10	.1.3.6.1.4.1.161.19.3.2.1.114	Priority for the tenth color code. (See colorCodepriority2 for values).

In addition, two timers can be configured on the AP by the operator. The timers' configurations are sent down to the SM during registration negotiations. These timers are only used when the SM is registered to an AP with a non-Primary Color Code.

The timers allow an SM to "time-out", rescan, and attempt to register to an AP with a Primary Color Code. These timers only fire if the SM is still in session when they expire.

The first timer (Subscriber Color Code Rescan) will only fire once. This timer event can do two actions depending on the setting of the second timer. If the second timer's (Subscriber Color Code Wait Period for Idle) configuration was enabled, then this event will start the idle timer. If the idle timer was disabled (set to zero), then the subscriber will immediately go into rescan mode.

The "Wait for Idle" timer will fire periodic events. The fired event determines if any RF unicast traffic (either inbound or outbound) has occurred since the last event. If the results of the event determined that no RF unicast traffic has occurred (idle), then the subscriber will rescan.

A value of zero (0) means that these timers are disabled.

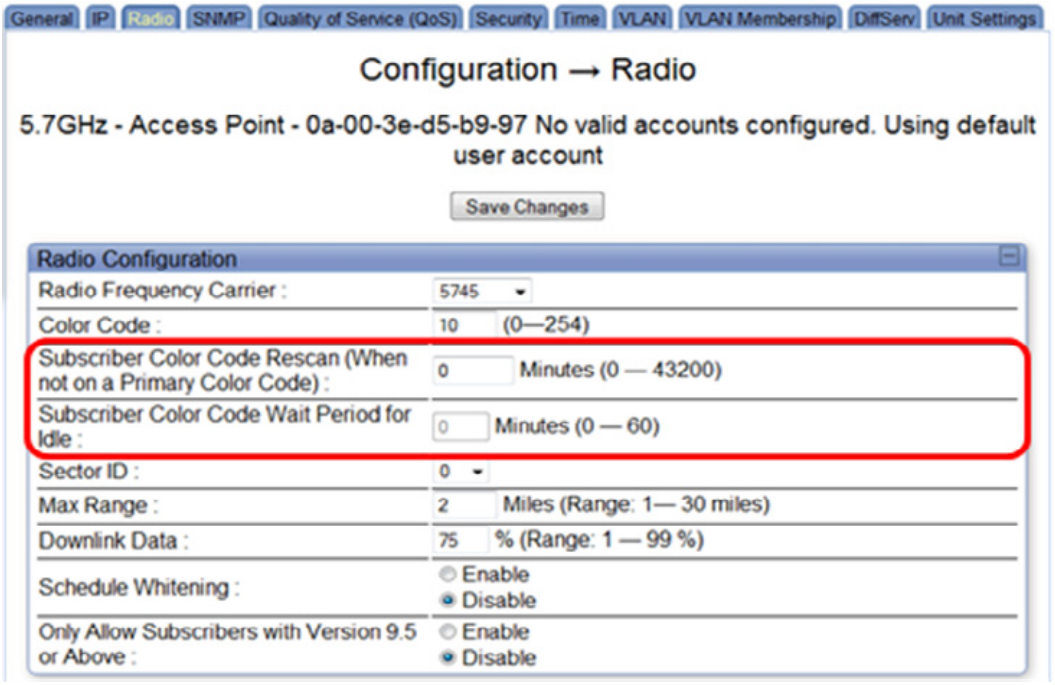


Figure 12: Configure SM Color Code Rescan and Wait Period via Configuration => Radio on AP.

The AP MIB changes are as follows:

Name	Value	Description
colorCodeRescanTimer	.1.3.6.1.4.1.161.19.3.1.1.64	The time (in minutes) for a subscriber to rescan (if this AP is not the SM's primary color code). A value of zero (0) disables the timer. MultiPoint systems only.
colorCodeRescanIdleTimer	.1.3.6.1.4.1.161.19.3.1.1.65	The time (in minutes) for the subscriber to rescan while idle on RF unicast data (if this AP is not the SM's primary color code). A value of zero (0) disables the timer. MultiPoint Systems only.

2.12 GPS COORDINATES STORED IN AP, SM AND BH

GPS coordinates can be manually entered into each AP, SM and BH.

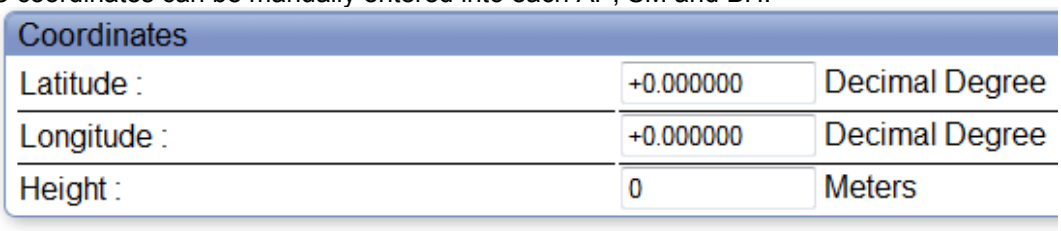


Figure 13: Enter GPS Coordinates via Configuration => General on AP, SM and BH.

This table shows the three GPS coordinate OIDs.

Name	Value	Description
Latitude	.1.3.6.1.4.1.161.19.3.3.2.88	Customer configured latitude in decimal degrees.
Longitude	.1.3.6.1.4.1.161.19.3.3.2.89	Customer configured longitude in decimal degrees.
Height	.1.3.6.1.4.1.161.19.3.3.2.90	Customer configured height in meters.

2.13 CONFIGURATION TO HIDE IDLE SUBSCRIBERS ON AP

Idle subscribers can be quickly hidden (without a reboot) from the Home => Session Status list on the AP by selecting Enabled. This can be useful to clean up the Session Status List to only show active subscribers. It is also useful when using the AP/SM Pre Shared Key configuration since any SMs which fail authentication will show up as idle in the Session Status List.
The default value is Enabled.

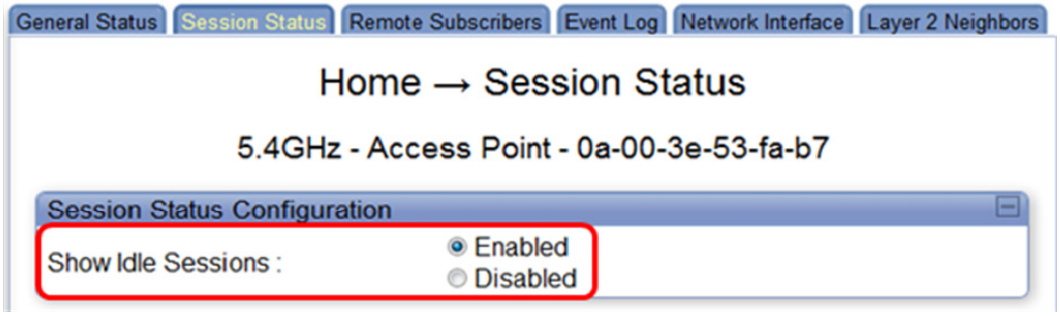


Figure 14: Enable or Disable Idle Sessions via Home => Session Status on AP.

2.14 QUICK LOGIN ON AP, SM AND BH

The login “Username” and “Password” fields are now located on the lower left hand side of the Home => General Status page.

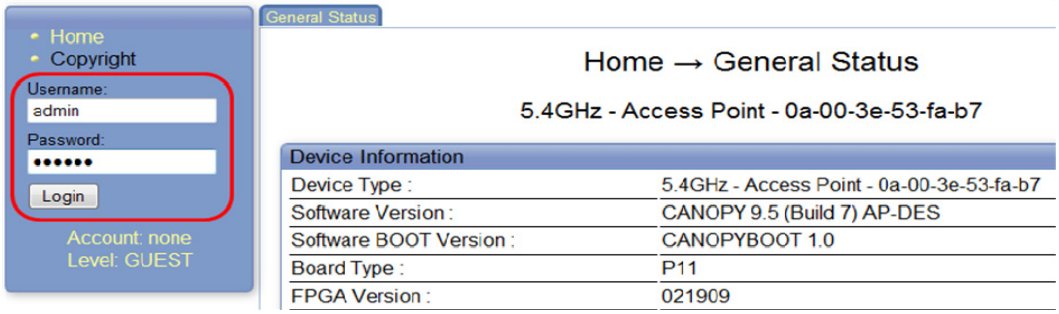


Figure 15: Quick login via Home => General Status on AP, SM and BH.

2.15 OBSOLETE UNUSED OIDS

This table shows the six OIDs that are no longer used and have been removed from the MIBs.

Name	OID
highPriorityUpLnkPct	1.3.6.1.4.1.161.19.3.1.1.5
numUAckSlots	1.3.6.1.4.1.161.19.3.1.1.6
uAcksReservHigh	1.3.6.1.4.1.161.19.3.1.1.7
numDAckSlots	1.3.6.1.4.1.161.19.3.1.1.8
dAcksReservHigh	1.3.6.1.4.1.161.19.3.1.1.9
numCtlSlotsReserveHigh	1.3.6.1.4.1.161.19.3.1.1.11

2.16 ONLY ALLOWING AP TO REGISTER SMS THAT ARE ON AT LEAST RELEASE 9.5

For feature compatibility, an operator can enforce that all SMs in a sector are running 9.5 software or above. If an SM that is running pre-9.5 software tries to register to an AP with this option enabled, it will be rejected and an SM registration failure trap will be sent indicating why the SM was not allowed to register.

To allow only SMs that are running release 9.5 or above to register to an AP, enable "Only Allow Subscribers with Version 9.5 or Above" via the Configuration => Radio tab or via SNMP.

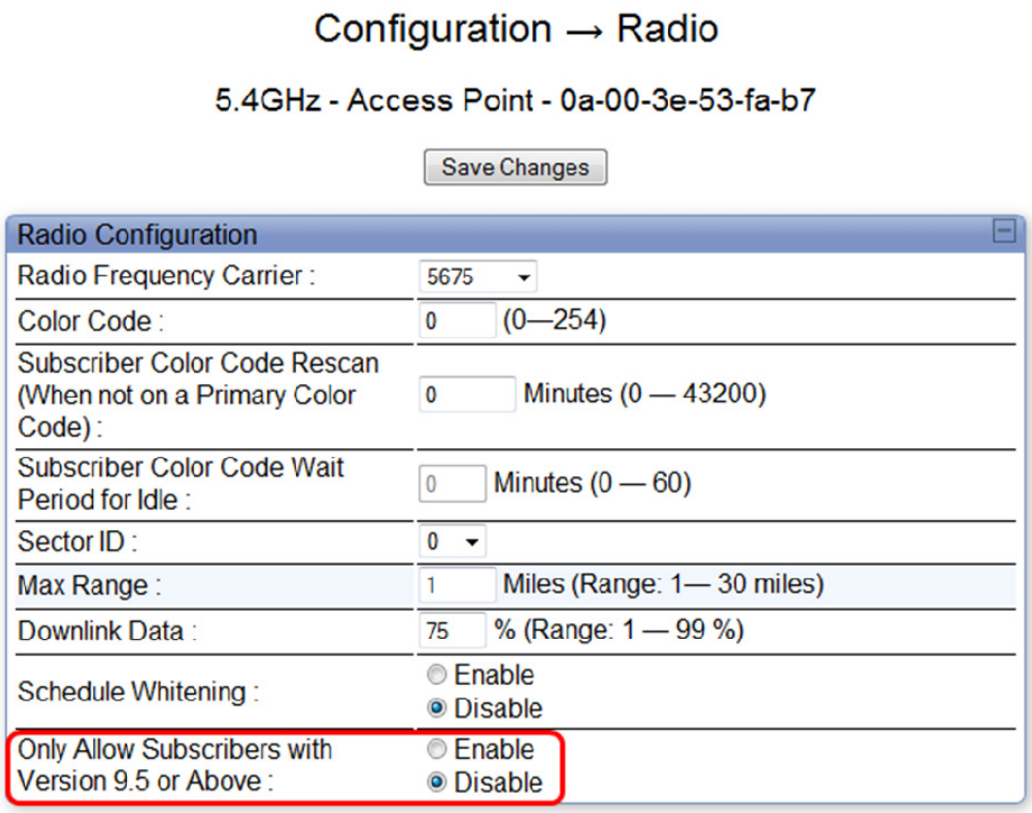


Figure 16: Only allow SMs running R9.5 or above via Configuration => Radio on AP.

The SNMP control is defined in the AP MIB file, under the whispApsConfig group. The OID is .1.3.6.1.4.1.161.19.3.1.1.69.0 (onlyAllowVer95OrAbove) and is a "Boolean"type. A value of zero (0) disabled this feature, while a value of one (1) enables it.

2.17 CLEAR STATISTICS ON AP, SM AND BH

Prior to Release 9.5, the only way to clear statistics on the AP, SM or BH was to reboot the radio. In Release 9.5, the AP, SM and BH Statistics pages can be cleared one tab at a time without requiring a reboot of the radio. Upon clicking the “Clear Statistics” button the statistics zero out and begin to increment.

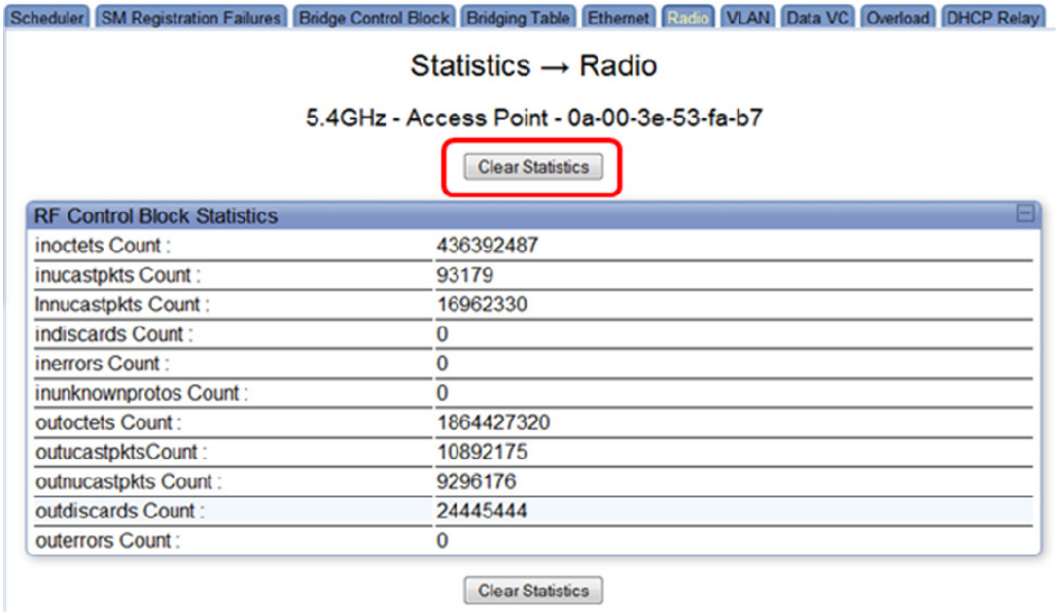


Figure 17: Clear Statistics button via Statistics on AP, SM and BH.

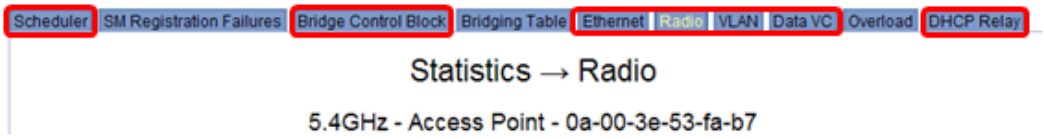


Figure 18: Clear Statistics on AP - web tabs that can be cleared are shown in red.

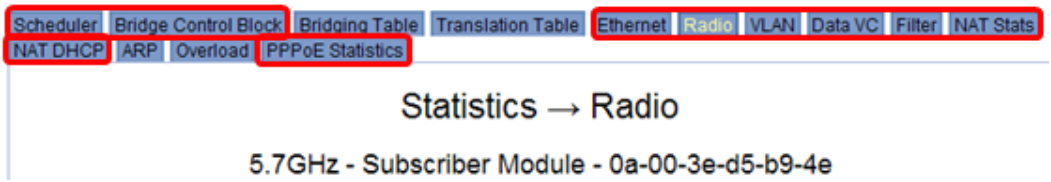


Figure 19: Clear Statistics on SM - web tabs that can be cleared are shown in red.

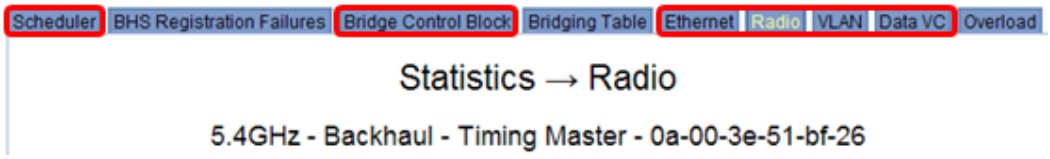


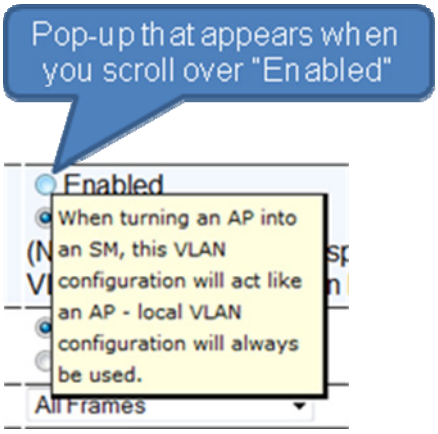
Figure 20: Clear Statistics on BH - web tabs that can be cleared are shown in red.

2.18 POP-UP TOOL TIPS

The following list of web pages contains tool tip pop-ups to explain specific radio features.

- SM - Packet Filter Types located in Configuration => Protocol Filtering
- SM - Filter Direction located in Configuration => Protocol Filtering
- SM/BH - Large VC data Q located in Configuration => Radio
- AP - Subscriber Color Code Rescan located in Configuration => Radio
- AP - Subscriber Color Code Wait Period for Idle located in Configuration => Radio
- AP - Always use Local VLAN Config located in Configuration => VLAN

  Note: Enable VLAN to see Always use Local VLAN Config tool tip



- AP/SM/BH – Latitude, Longitude and Height tool tip in Configuration => General

2.19 900-MHZ LIMITED AP

Release 9.5 supports the new 900-MHz Limited AP radio model (9060APC). This AP is known as an APL device type and can register up to ten 900-MHz SMs. If an eleventh SM tries to register to the 900-MHz Limited AP, it will receive a registration grant failure with either reason “SM Limit Exceeded” or “Auth Failure”. Refer to section 2.6 for more details on registration failures.

The 900-MHz Limited AP is sold as a kit with one 900-MHz Limited connectorized AP and ten 900-MHz connectorized SMs. A 900-MHz Limited AP can be upgraded to an Advantage AP via an orderable feature key.

When using the new 900-MHz Limited AP, consider using the new AP/SM Pre-shared Key Authentication with different keys for different sectors to force the desired mapping of SMs to APs and avoid SMs being denied service by their AP's 10-SM limit being filled with the "wrong" SMs. Refer to section 2.7 for more details on AP/SM Pre-shared Key authentication.

2.20 SUPPORT FOR P11 HARDWARE

5.2-GHz and 5.4-GHz P11 modules require, at a minimum, Release 9.4.x.
These modules should be upgraded to Release 9.5 before being deployed.

5.7-GHz P11 modules require, at a minimum, Release 9.3.
These modules should be upgraded to Release 9.5 before being deployed.

P11 modules exhibit performance similar to P10, as shown in Table 4 on page 13.

2.20.1 Mixing Hardware Vintages

P11 APs and SMs can be mixed with other hardware vintages in a sector. P11 BHs can be mixed with P9 and P10 BHs on a link.

2.20.2 Mixing Software Releases

Before deploying P11 hardware into a R9.5 sector, existing APs and SMs in the sector should first be upgraded to Release 9.5.

3 Resolved Issues

Issues resolved in Release 9.5 are listed in Table 6.

Table 6: Issues resolved in Release 9.5

Ref #	Description	Explanation
11590	PMP 400 and PTP 200 OFDM potential radio communication failure	Due to an issue in previous releases, PMP 400 and PTP 200 OFDM modules have a potential to drop the radio communication link (appear to fail) as they age. This issue does not affect PMP 100 and PTP 200 FSK modules.
10402	NTP Event Log	Beginning with Release 9.4, new PermLogs were added for the NTP client to notify the user of reasons why the time may not have been updated via NTP. These logs were put into the radio Event Log. Customers reported that the event log was filling up with messages. Starting with Release 9.5, these event logs have been moved to the Configuration => Time page on the AP under NTP Update Log. The new OID to retrieve this log via SNMP is: Name: ntpLogSNMP OID: 1.3.6.1.4.1.161.19.3.1.7.33 Description: EventString The NTP Update Log will show the last 20 events for NTP time updates. NTP will try to update the time every 5 minutes.
11147	AP SNMP Queries impact VoIP traffic	In prior releases, somewhat degraded VoIP performance could be observed while simultaneously running SNMP queries. This is resolved in Release 9.5.
9798	Ranging issues at maximum settings (Applies to 4.9 & 5.4GHz OFDM – PMP 49400 and 54400)	Some ranging issues have been resolved. Previously, due to occasional ranging issues at higher settings, a sector configured for a Max Range of 11 miles or greater should have its Downlink Data set no higher than 80%. Max Range and Data Downlink are set on the AP's Configuration => Radio page. Sectors configured for a Max Range of 10 miles or less were not affected by this limitation.
9711	ARP table shows 00-00-00-00-00-00 for the NAT WAN interface	The SM's Statistics => ARP page shows the correct physical address for the IP address as shown in the Public RF NAT Table further down on the page.

<table>
<tr><th>Ref #</th><th>Description</th><th>Explanation</th></tr>
<tr><td>10300</td><td>Added OIDs for High Priority Channel Stats</td><td>
OIDs were added to the whispLinkTable for the High Priority Channel statistics. If there is no high priority channel enabled, the entries will all return values of 0.

OIDs added for P9, P10 and P11 hardware:
- OID to check if high priority channel is enabled. This OID should be used to validate the rest of the new “HiQ”OIDs to determine if 0 is a valid number or just N/A if high priority isn’t enabled.
- OID to get the VC number for low and high priority (if enabled) channels(s).

OID added for P7 & P8 hardware:
- Operators should us the p7p8HiPriQEn and p7p8HiPriQ OIDs for P7 and P8 device types. P7 and P8 radios do not use a separate VC for their high priority Q.

OIDs for High Priority Channel Stats
<table>
<tr><th>OID</th><th>Name</th><th>Type</th></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.48</td><td>dataVCNum</td><td>INTEGER</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.49</td><td>hiPriQEn</td><td>INTEGER</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.50</td><td>dataVCNumHiQ</td><td>INTEGER</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.51</td><td>linkInOctetsHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.52</td><td>linkInUcastPktsHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.53</td><td>linkInNUcastPktsHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.54</td><td>linkInDiscardsHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.55</td><td>linkInErrorHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.56</td><td>linkInUnknownProtosHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.57</td><td>linkOutOctestsHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.58</td><td>linkOutUcastPktsHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.59</td><td>linkOutNUcastPktsHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.60</td><td>linkOutDiscardsHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.61</td><td>linkOutErrorHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.62</td><td>vcQOverflow</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.63</td><td>vcQOverflowHiQ</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.64</td><td>P7p8HiPriQEn</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.1.4.1.65</td><td>P7p8HiPriQ</td><td>Counter32</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Ref #</th><th>Description</th><th>Explanation</th></tr>
<tr><td>10595
&
10596</td><td>Added OIDs for Scheduler and Bridge Control Block Stats</td><td>OIDs were added to match the already-available-via-GUI Scheduler stats. Also, OIDs have been added for the first three sections of the Bridge Control Block page.

Scheduler and Bridge Control Block OIDs
<table>
<tr><th>OID</th><th>Name</th><th>Type</th></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.37</td><td>bridgeCbFecStatbin</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.38</td><td>bridgeCbFecStatbout</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.39</td><td>bridgeCbFecStatbtoss</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.40</td><td>bridgeCbFecStatbtosscap</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.41</td><td>bridgeCbFecStatuin</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.42</td><td>bridgeCbFecStatuout</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.43</td><td>bridgeCbFecStatutoss</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.44</td><td>bridgeCbFecStatutosscap</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.45</td><td>bridgeCbRFStatbin</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.46</td><td>bridgeCbRFStatbout</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.47</td><td>bridgeCbRFStatbtoss</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.48</td><td>bridgeCbRFStatbtosscap</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.49</td><td>bridgeCbRFStatuin</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.50</td><td>bridgeCbRFStatuout</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.51</td><td>bridgeCbRFStatutoss</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.52</td><td>bridgeCbRFStatutosscap</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.53</td><td>bridgeCbErrStatNI1QSend</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.54</td><td>bridgeCbErrStatNI2QSend</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.55</td><td>bridgeCbErrStatBridgeFull</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.56</td><td>bridgeCbErrStatSendMsg</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.57</td><td>bridgeCbErrStatAPFecQSend</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.58</td><td>bridgeCbErrStatApRfQSend</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.59</td><td>rfStatXmtUDataCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.60</td><td>rfStatXmtBDataCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.61</td><td>rfStatRcvUDataCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.62</td><td>rfStatRcvBDataCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.63</td><td>rfStatXmtCntlCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.64</td><td>rfStatRcvCntlCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.65</td><td>rfStatInSyncCount</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.66</td><td>rfStatOutSyncCount</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.67</td><td>rfStatOverrunCount</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.68</td><td>rfStatUnderrunCount</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.69</td><td>rfStatRcvCorruptDataCount</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.70</td><td>rfStatBadBcastCtlCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.71</td><td>rfStatPLLOutOfLockCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.72</td><td>rfStatBeaconVerMismatchCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.73</td><td>rfStatBadFreqBcnRcvCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.74</td><td>rfStatnonLiteBcnRcvCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.75</td><td>rfStatUnsupFeatBcnRcvCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.76</td><td>rfStatUnkwnFeatBcnRcvCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.77</td><td>rfStatTxCalFailCnt</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.78</td><td>rfStatBadInSyncDRcv</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.79</td><td>rfStatTempOutOfRange</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.80</td><td>rfStatRSSIOutOfRange</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.81</td><td>rfStatRangeCapEnf</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.82</td><td>rfStatRcvLTStart</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.83</td><td>rfStatRcvLTStartHS</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.84</td><td>rfStatRcvLTResult</td><td>Counter32</td></tr>
<tr><td>1.3.6.1.4.1.161.19.3.3.1.85</td><td>rfStatXmtLTResult</td><td>Counter32</td></tr>
</table></td></tr>
<tr><td>10824</td><td>Loss of Ping with Translation Bridging Enabled</td><td>An issue with pings not replying after a period of time when using Translation Bridging and VLAN has been resolved.</td></tr>
</table>

<table>
<tr><th>Ref #</th><th>Description</th><th>Explanation</th></tr>
<tr><td>10053</td><td>Translation Bridge Table Access via SNMP</td><td>When Translation Bridge is enabled, every SM maintains a translation bridge table. The entries of this table are now also accessible via SNMP (Read only access). The entries in this table are dynamically added/deleted based upon the devices are under the SM. The max number of entries for this table is 128.

Translation Bridge Table OIDs
<table>
<tr><th>Stat Name</th><th>Description</th><th>OID</th></tr>
<tr><td>WhispSmTranslationTable</td><td>Entries in the SM Translation Table</td><td>.1.3.6.1.4.1.161.19.3.2.6

Table</td></tr>
<tr><td colspan="3">Each Entry in WhispSmTranslation Table consists of the following elements (value of x can be from 1-128 depending on the number of entries in the translation table)</td></tr>
<tr><td>WhispTranslationTableMacAddr</td><td>Mac Address of the translated device</td><td>.1.3.6.1.4.1.161.19.3.2.6.1.2.x

OctetString</td></tr>
<tr><td>WhispTranslationTableIpAddr</td><td>IP Address of the translated device</td><td>.1.3.6.1.4.1.161.19.3.2.6.1.3.x

IpAddress</td></tr>
<tr><td>WhispTranslationTableAge</td><td>Age of the entry</td><td>.1.3.6.1.4.1.161.19.3.2.6.1.4.x

Counter 32</td></tr>
</table>
</td></tr>
<tr><td>10094</td><td>DNS Proxy/Relay for NAT SMs</td><td>In 9.5, a NAT SM will now act as the DNS Server to all devices underneath of it. When the SM gives out a DHCP lease, it will specify itself as the DNS server. This fixes problems where the DNS servers change or the radio WAN interface is specified to automatically get DNS information via DHCP or PPPoE. In these cases, when the DNS servers change, or when a radio first get a lease, any devices below the NAT SM that already have retrieved a lease would not know about the new DNS servers. They would have to be rebooted or their leases would have to be manually renewed. Now, with the SM acting as the DNS server, devices underneath will always point to the SM for DNS queries. The SM will then forward the packet onto the proper DNS server based on the radios current DNS settings and will forward the response to the customer device. This is all done with the existing NAT implementation. When the radio sees a DNS query, it simply swaps out the destination IP with one of the DNS servers, then sends the packet through the NAPT for translation and forwarding. Once the response comes back, it’s translated back through the NAPT, then the source IP is swapped out with the radio IP so that the customer equipment thinks that it came from the radio. There are no new OID or GUI changes.

Please see Section 4: Known Open Issues - SM - DNS below a NATed SM (R9.5)</td></tr>
</table>

<table>
<tr><th>Ref #</th><th>Description</th><th>Explanation</th></tr>
<tr><td>10213, 10234 & 10237</td><td>Improvements to SNMP Mibs</td><td>
SNMP Mibs now import the “Unsigned32” type from the SNMP v2 standard; therefore, the following OIDs have been changed from “INTEGER” to…

…Unsigned32 OIDs
<table>
<tr><th>Name</th><th>OID</th><th>MIB File</th></tr>
<tr><td>airDelay</td><td>.1.3.6.1.4.1.161.19.3.2.2.4</td><td>SM</td></tr>
<tr><td>dataSlotUpHi</td><td>.1.3.6.1.4.1.161.19.3.1.7.7</td><td>AP</td></tr>
<tr><td>upLnkAckSlot</td><td>.1.3.6.1.4.1.161.19.3.1.7.8</td><td>AP</td></tr>
<tr><td>upLnkAckSlotHi</td><td>.1.3.6.1.4.1.161.19.3.1.7.9</td><td>AP</td></tr>
<tr><td>dwnLnkAckSlot</td><td>.1.3.6.1.4.1.161.19.3.1.7.10</td><td>AP</td></tr>
<tr><td>dwnLnkAckSlotHi</td><td>.1.3.6.1.4.1.161.19.3.1.7.11</td><td>AP</td></tr>
<tr><td>numCtrSlot</td><td>.1.3.6.1.4.1.161.19.3.1.7.12</td><td>AP</td></tr>
<tr><td>numCtrSlotHi</td><td>.1.3.6.1.4.1.161.19.3.1.7.13</td><td>AP</td></tr>
<tr><td>regCount</td><td>.1.3.6.1.4.1.161.19.3.1.7.1</td><td>AP</td></tr>
</table>

… Gauge32 OIDs
<table>
<tr><th>Name</th><th>OID</th><th>MIB File</th></tr>
<tr><td>linkLastJitter</td><td>.1.3.6.1.4.1.161.19.3.1.4.1.23</td><td>AP</td></tr>
<tr><td>linkAveJitter</td><td>.1.3.6.1.4.1.161.19.3.1.4.1.22</td><td>AP</td></tr>
<tr><td>Jitter</td><td>.1.3.6.1.4.1.161.19.3.2.2.3</td><td>SM</td></tr>
<tr><td>minJitter</td><td>.1.3.6.1.4.1.161.19.3.2.2.34</td><td>SM</td></tr>
<tr><td>maxJitter</td><td>.1.3.6.1.4.1.161.19.3.2.2.35</td><td>SM</td></tr>
</table>

The below OIDs were mislabeled as INTEGER instead of a counter. They were changed to the appropriate “Counter32” type.

Counter32 OID Changes
<table>
<tr><th>Name</th><th>OID</th><th>MIB File</th></tr>
<tr><td>pppoeControlBytesSent</td><td>.1.3.6.1.4.1.161.19.3.2.2.46</td><td>SM</td></tr>
<tr><td>pppoeControlBytesReceived</td><td>.1.3.6.1.4.1.161.19.3.2.2.47</td><td>SM</td></tr>
<tr><td>pppoeDataBytesSent</td><td>.1.3.6.1.4.1.161.19.3.2.2.48</td><td>SM</td></tr>
<tr><td>pppoeDataBytesReceived</td><td>.1.3.6.1.4.1.161.19.3.2.2.49</td><td>SM</td></tr>
<tr><td>rxOverrunPkts</td><td>.1.3.6.1.4.1.161.19.3.3.1.34</td><td>BOX</td></tr>
<tr><td>nbPriBitsErr</td><td>.1.3.6.1.4.1.161.19.3.2.2.27</td><td>SM</td></tr>
<tr><td>nbSndBitsErr</td><td>.1.3.6.1.4.1.161.19.3.2.2.28</td><td>SM</td></tr>
</table>

The following OIDs had the correct type (Counter32) but were declared Counter64 in the WispLinkEntry table. The WispLinkEntry table was updated to the correct type (Counter32). The Table OID is .1.3.6.1.4.1.161.19.3.1.4. (linkInOctets, linkInUcastPkts, linkInNUcastPkts, linkOutOctets, linkOutUcastPkts, linkOutNUcastPkts)
</td></tr>
</table>

4 Known Open Issues

Known open issues for Release 9.5 are listed in Table 7.

Table 7: Known open issues

Product Family	Description	Discussion and Recommendations
All	SM - DNS below a NATed SM (R9.5)	Microsoft Vista and presumably Windows 7 will not route a 169.254/16 subnet used as the default Canopy subnet since Microsoft uses 169.254/16 subnet to talk between local machines. This is not an issue if: - the PC is connected directly to the NATed SM. - the NAT/routing CPE underneath the NATed SM provides DNS services. However; if a NAT/routing CPE that is not providing DNS services (e.g. some home routers*) is placed between the SM and the user's PC, a Microsoft Vista and Windows 7 machine will not route to the default 169.254/16 SM IP address space to access DNS services. **Workaround:** Reconfigure the SMs NAT LAN address to a private IP address such as 192.168/16, 172.16/12, or 10/8. * Please refer to home router manufacturer documentation to determine if the router provides DNS services.
All	Prizm 3.2 cannot change LED Panel Mode. (9764)	Prizm 3.2 cannot set the LED Panel Mode to Revised Mode. LEDs are in Legacy Mode by default. **Workaround**: Set LED Panel Mode using the GUI.
PMP 100	Downlink broadcast traffic on FSK radios can exhibit packet loss (9492)	**Broadcast Repeat Count** on the AP's Configuration => Radio page should not be set to 0. Use either 1 or 2 repeats. **Workaround:** When using applications such as broadcast video that make significant use of downlink broadcast packets, set the parameter to 1. Otherwise, in most cases, leave the parameter set to the default of 2. This issue has been resolved for OFDM radios, but can still affect FSK radios running Release 9.4.2.

5 Notes and Reference

5.1 NOTES

New notes for Release 9.5 are listed in Table 8 and previous notes are listed in Table 9.

Table 8: Notes

Ref #	Description	Discussion and Recommendations
11383	SNMP Set of Region Code fails in some cases	Consistent with the changes described above for Release 9.5, attempting an SNMP Set of the Region Code of a US 5.2-, 5.4-, or 5.7-GHz AP or BHM that was upgraded to Release 9.5 will return a “failed” response. SNMP Gets continue to return correct responses.
9652	Uplink Efficiency is just 88% for the 64Bytes Packet Length (4.9GHz OFDM Only)	This is a reporting issue only when conducting a link test with 64Bytes packets while the radio is operating in 3X modulation. If the radio is conducting a link test while operating at 2X it will report 100% link efficiency.
11699	Updating Community Strings on the Web GUI	To flip-flop the read/write and read-only community string names, it is necessary to change one community string to a temp name first before switching community string names.
10333	Link Status Page	The AP or SM Tools => Link Status Page displays NA for Latest Remote Link Efficiency Percentage. To update, either turn on web page auto update or press F5 to refresh the web page.
7427	AP Sync Input	Remote AP receives sync from SM by setting SYNC Input to Timing Port. However; if this is incorrectly configured as SYNC input to Power port the remote AP will still correctly receive SYNC.

Table 9: Previous notes

ID	Description	Discussion and Recommendations
-	Changes to boxTemperature OIDs	Starting with Release 9.4 the boxTemperature (1.3.6.1.4.1.161.19.3.3.1.5) OID (which returned an octet string value) is no longer valid. Two new OIDS which return integer values are added: boxTemperatureC Object ID: 1.3.6.1.4.1.161.19.3.3.1.35 Syntax: INTEGER Access: read-only Status: current Radio temperature in Celsius. boxTemperatureF Object ID: 1.3.6.1.4.1.161.19.3.3.1.36 Syntax: INTEGER Access: read-only Status: current Radio temperature in Fahrenheit.
10263	Disable TCP ACK prioritizing in broadcast video applications	When optimizing a system for broadcast video, on the AP's Configuration => General page configure **Prioritized TCP ACK** to **Disabled**. In a system being used for internet access or similar applications prioritizing TCP ACKs improves downloading of FTP files and other activities making significant use of TCP ACKs under heavy load. However, in a system being used for broadcast video or video surveillance, prioritizing TCP ACKs can cause sporadic choppy video in the uplink.
9574	5.4-GHz OFDM BHs may see a 600 kbps reduction in uplink or downlink throughput	Guard times in the OFDM PTP scheduler were increased slightly, changing the ranges at which time slots are lost to air delay. Depending on the distance between BHs and the configured Downlink Data %, this may or may not affect a given installation. For example, at 0 miles and 50% Downlink Data the uplink/downlink slots change from 33/33 in Release 8.4.3 to 33/32 with Release 9.4.2, resulting in 600 Mbps less downlink throughput. However, at 3 miles the slots are 32/32 for both Release 8.4.3 and Release 9.4.2 resulting in no change in throughput between the releases.
-	More accurate Received Power readings for P10 900-MHz radios	For P10 900-MHz radios, Release 9.4 included improvements in the accuracy of the displayed Received Power based on improvements in temperature measurement. The displayed Received Power may be lower or higher than for the same radio running a previous release. The actual performance of the radio has not changed. With this accuracy improvement, P10 900-MHz radios should see less variation of displayed Received Power over time (as temperature changes) and from radio to radio.
8484	Procedures for saving an XML file of a spectrum graph	When the **SpectrumAnalysis.xml** button is clicked on the SM's Tools => Spectrum Analyzer page or the AP's Tools => Remote Spectrum Analyzer page, the spectrum graph is redisplayed using XML and XSL if the browser supports XSL. To save the underlying XML file, right click and select "Save Target As" on a Windows PC, or equivalent action for other operating systems.
8172	SM scan frequencies not "cancelled" by SNMP actions	If you make frequency changes on the SM GUI, and then back them out using SNMP, the Reboot Required message remains on the GUI. Workaround: If it says Reboot Required, go ahead and reboot, just to clear the message.

ID	Description	Discussion and Recommendations
8241	Avoid power cycling modules during upgrading	Power cycling a module while it is upgrading can cause anomalous events, such as rebooting every time you try to access the GUI. Recovery: Attempt to upgrade again. If CNUT reports the module as upgraded and refuses to upgrade again, downgrade the module and then upgrade it again.
None	Managing module accounts and passwords	The best security practice is to be aware the unit starts with `root` and `admin` accounts, to plan your approach to accounts, and set passwords for all accounts. A module that either is fresh from the factory or has been operator-reset to factory defaults has two user accounts: `root` and `admin`, both with ADMINISTRATOR level permissions. To secure a module, access the Account => Change Users Password tab and add a password to each of these accounts. Adding a password to only one account still leaves the other open. Furthermore, an account without a password will accept any password potentially giving the impression the unit is protected when it isn't. Alternatively, an operator's practices may be to delete the `admin` account or delete the `root` account and replace them with their own account(s). By default Prism and CNUT use the `root` account to manage the module, so if you delete `root` accounts on modules you will need to make coordinated changes to Prizm and CNUT to access them with your own accounts.
7808	Use up to 16 alphanumeric characters in user account names, passwords, and Community Strings	SNMP doesn't do data-entry checking, so more than 16 characters may be entered, but only 16 characters will be saved and displayed. You can set Community Strings that include characters like ~`!@#$%^&;*()_+[]{}|;:,./<>? from the GUI, but SNMP only accepts alphanumeric characters and SNMP get or set commands will return errors.
7442	Timed Spectrum Analyzer settings anomaly	Values of **Timed Spectrum Analyzer** duration and **Spectrum Analysis on Boot** get saved by clicking any button on the page, not just when clicking **Save Changes** or **Start Time Spectrum Analysis** (which is typical operation for other pages).
None	Best Practice is to set SM to same **Region Code** as AP	When an SM registers to an AP, it assumes the Region Code and associated parameters of the AP, disregarding any Region code set in the SM by you. However, the best practice is still for you to set a Region Code in the SM so that displayed options are consistent with the region.
4831	Details on pinging Canopy modules	A ping size larger than 1494 Bytes to a Canopy module times out and fails. However, a ping of this size or larger to a system that is behind a Canopy module typically succeeds. It is generally advisable to ping such a system, since Canopy handles that ping with the same priority as is given all other transport traffic. The results are unaffected by ping size and by the load on the Canopy module that brokers this traffic.
5298	AP may be listed twice in AP Evaluation tab	To help during aiming, the Tools => AP Evaluation tab maintains AP entries for 15 minutes. If the frequency of an AP is changed, for 15 minutes the AP is listed twice in the AP Evaluation tab, once with the former frequency, and once with the new.

ID	Description	Discussion and Recommendations
4789	Lowest settable **Transmitter Output Power** varies	The low end of the **Transmitter Output Power** can vary from radio to radio due to manufacturing tolerances. If you set this parameter to lower than the range capable on a radio, the value is automatically reset to the lowest capable. ***NOTE:*** The high end of the range of settable **Transmitter Output Power** does not vary from radio to radio.
4844, 2756	When using **Link Test with MIR**, need to set both ends	To see the effects of MIR capping, you can run a link test with MIR enabled. To get meaningful results, set **Link Test with MIR** to **Enabled** on the Tools => Link Capacity Test tab *in both* the SM and the AP. When it is enabled on only one end, results are misleading. After you run perform a link test with MIR capping enabled, consider immediately changing **Link Test with MIR** to **Disabled** *in both* the SM and the AP, to avoid mistakenly capping only one end of the link test.
5284	Click Spectrum Analyzer **Enable** button twice	After you click the **Enable** button in the Tools => Spectrum Analyzer tab, the resulting display may omit bars for some frequencies, especially in frequency bands that have a large number of center channels, such as the 5.4-GHz band. If you clicking **Enable** again, the display includes the entire spectrum bar graph. ***TIP:*** In the Configuration => General tab, set the **Webpage Auto Update** parameter to a few seconds, to have the Spectrum Analyzer automatically fully displayed and refreshed. You can later reset the **Webpage Auto Update** time back to `0`, to disable refresh.
4706	Blank screen after logging in to SM through AP Session Status tab	In some instances, depending on network activity and network design, the interface presents a blank screen to a user who logs in to an SM through the Home => Session Status tab in the AP. If you observe this, refresh your browser window.
5407	5590 through 5660 may interfere with weather radar, not allowed in Europe, Canada, and Australia	Canopy center channel frequencies of 5590 MHz through 5660 MHz may interfere with, or be interfered by, weather radar in several Regions, including Europe, the US, Canada, and Australia. In Europe, Canada, and Australia, to be in regulatory compliance, operators *must not* transmit on these frequencies. Setting the **Region Code** to **Europe**, **Canada** or **Australia** notches out these frequencies and ensures compliance. Operators who perform a site survey in the United States should use the built-in Spectrum Analyzer or a stand-alone spectrum analyzer to check for activity on these channels and select other channels as appropriate.
7557	When connecting to a hub, use only half duplex Ethernet settings	Ethernet connections set to **10 Base T Full Duplex** or **100 Base T Full Duplex** will not connect to an SM through a hub, due to the way a hub works. Use half duplex settings when using a hub.

5.2 OPERATION BASED ON REGION CODE AND FREQUENCY BAND

For reference, Table 10 shows operation based on Region Code, by frequency band and module type. Changes for Release 9.5 are highlighted in **Bold.**

Table 10: Release 9.5 operation based on Region Code and frequency band

Region Code[1]	900 MHz	2.4 GHz	4.9 GHz	5.1 GHz	5.2 GHz		5.4 GHz		5.7 GHz	
	AP/SM	AP/SM /BH	AP/SM /BH	AP/SM/ BH	AP/ BHM	SM/ BHS	AP/ BHM	SM/ BHS	AP/ BHM	SM/ BHS
United States	No effect	No effect	No effect	NA	≥P10: FCC/IC DFS ≤ P9: no DFS	No effect	FCC/IC DFS No 5590-5660 MHz in FSK[2] No 5600-5650 MHz in OFDM[2]	No effect	No effect	No effect
Canada	No effect	No effect	No effect	NA	≥ P10: FCC/IC DFS ≤ P9: no DFS	No effect	FCC/IC DFS No 5590-5660 MHz in FSK[2] No 5600-5650 MHz in OFDM[2]	No effect	No effect	No effect
Europe	NA	No effect	No effect	NA	NA	NA	P11: ETSI 1.4.1 DFS ≤ P10: ETSI 1.3.1 DFS >July 1, 08[3]: No 5590-5660 MHz in FSK[2] No 5600-5650 MHz in OFDM[2]	P11: ETSI 1.4.1 DFS ≤ P10: ETSI 1.3.1 DFS >July 1, 08[3]: No 5585-5665 MHz in FSK[2] No 5595-5655 MHz in OFDM[2]	P11: ETSI 1.4.1 DFS ≤ P10: ETSI 1.3.1 DFS	P11: ETSI 1.4.1 DFS ≤ P10: ETSI 1.3.1 DFS
Brazil	NA	NA	No effect	NA	NA	NA	P11: ETSI 1.4.1 DFS ≤ P10: ETSI 1.3.1 DFS	No effect	No effect	No effect
Australia	No effect	No effect	No effect	NA	NA	NA	FCC/IC DFS No 5590-5660 MHz in FSK[2] No 5600-5650 MHz in OFDM[2]	No effect	No effect	No effect

Region Code[1]	900 MHz	2.4 GHz	4.9 GHz	5.1 GHz	5.2 GHz		5.4 GHz		5.7 GHz	
	AP/SM	AP/SM /BH	AP/SM /BH	AP/SM/ BH	AP/ BHM	SM/ BHS	AP/ BHM	SM/ BHS	AP/ BHM	SM/ BHS
Russia	NA	NA	No effect	Display Com-munity options	No effect	No effect	NA	NA	No effect	No effect
Other	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect

1. In all cases, set the **Region Code** to the region you are in, and the software will determine the correct use of DFS.
2. Terminal Doppler Weather Radar (TDWR) operates on frequencies 5600 through 5650 MHz. In some countries a "weather notch" is required to avoid impinging on these frequencies.
3. Radios placed on market in Europe after July 1, 2008, can't impinge on weather radar frequencies. To meet this requirement, the software checks the date code of the module and implements the weather notch accordingly. You can tell if a 5.4-GHz module is "newer" or "older" by setting the Region Code to Europe – if the notch frequencies *are not* shown on the Configuration => Radio page, then the module is "newer", if the notch frequencies *are* shown, the module is "older".

6 Canopy MIB

The Canopy Enterprise MIB (Management Information Base), consisting of 5 MIB definition files, supports SNMP access to Canopy modules. The MIB files are available for download from the Canopy tab of http://motorola.wirelessbroadbandsupport.com/software.

Detailed information on the Canopy MIBs is available at http://motorola.wirelessbroadbandsupport.com/support/online_tools.

MIB files are used by Network Management Systems and Element Management Systems, such as the Motorola Prizm system, to support a host of surveillance, monitoring, control, and operational tasks.

Information on the Motorola Prizm element management system is available at http://motorola.wirelessbroadbandsupport.com/products/prizm.

Prizm documentation and installers are available for download from the Canopy tab of http://motorola.wirelessbroadbandsupport.com/software.

If you are using Prizm: Prizm software includes the MIB information. You do not need to load MIB files.

If you are using an SNMP network management system (NMS) or element management system (EMS) other than Prizm: Load the MIBs per the instructions for your NMS or EMS.

Important! When loading the Canopy MIB files

1. First load the standard MIB files.
2. Then load the Canopy MIB files.

Some NMSs are not sensitive to order, but some require a specific loading order to build a MIB tree. Loading in the recommended order avoids any problems arising from loading sequence.

7 Upgrading to Release 9.5

7.1 BEFORE YOU UPGRADE

7.1.1 Applicability

Table 11 shows the product series, hardware series, and radio types that are upgradeable to Release 9.5. **Yes** in larger bold font identifies radios that, if they are in the US, should be upgraded to Release 9.5 to ensure that systems are compliant with FCC guidance.

Table 11: Radios upgradeable to Release 9.5

Product Family	Radio Type	Frequency	Product Encryption Type							
			DES Product				AES Product			
			Hardware Vintage							
			P7, P8	P9	P10	P11	P7, P8	P9	P10	P11
PMP 100 (Canopy FSK)	SM	All	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
	AP	900, 2.4, 5.1, 5.9	No	Yes	Yes	Yes	No	Yes	Yes	Yes
		5.2, 5.4, 5.7	No	Yes	**Yes**	**Yes**	No	Yes	**Yes**	**Yes**
PTP 100 (Canopy FSK)	BH	2.4, 5.1, 5.9	No	Yes	Yes	Yes	No	Yes	Yes	Yes
		5.2, 5.4, 5.7	No	Yes	**Yes**	**Yes**	No	Yes	**Yes**	**Yes**
			All vintages				All vintages			
PMP 54400 (5.4-GHz OFDM)	SM	5.4	Yes				Yes			
	AP	5.4	**Yes**				**Yes**			
PTP 54200 (5.4-GHz OFDM)	BH	5.4	**Yes**				**Yes**			
PMP 49400 (4.9-GHz OFDM)	SM, AP	4.9	Yes				Yes			
PTP 49200 (4.9-GHz OFDM)	BH	4.9	Yes				Yes			

Yes in larger bold font identifies radios that, if they are in the US, should be upgraded to Release 9.5 to ensure that systems are compliant with FCC guidance.

Currently 5.7-GHz radios shipped to the US are P11 series, and 5.2- and 5.4-GHz radios shipped to the US are P10 series.

Release 9.5 is *not* applicable to

- PMP 500 Series modules (Canopy 3.5 GHz OFDM APs and SMs)
- PTP 300 Series Bridges
- PTP 400 Series Bridges (formerly 30-/60-Mbps backhaul modules)
- PTP 500 Series Bridges
- PTP 600 Series Bridges (formerly 150-/300-Mbps backhaul modules)
- CMMs (Cluster Management Modules)
- Powerline MU Gateway and Modem

7.1.2 Supported Upgrade Path

Upgrade paths for operating sectors are shown in Figure 21.

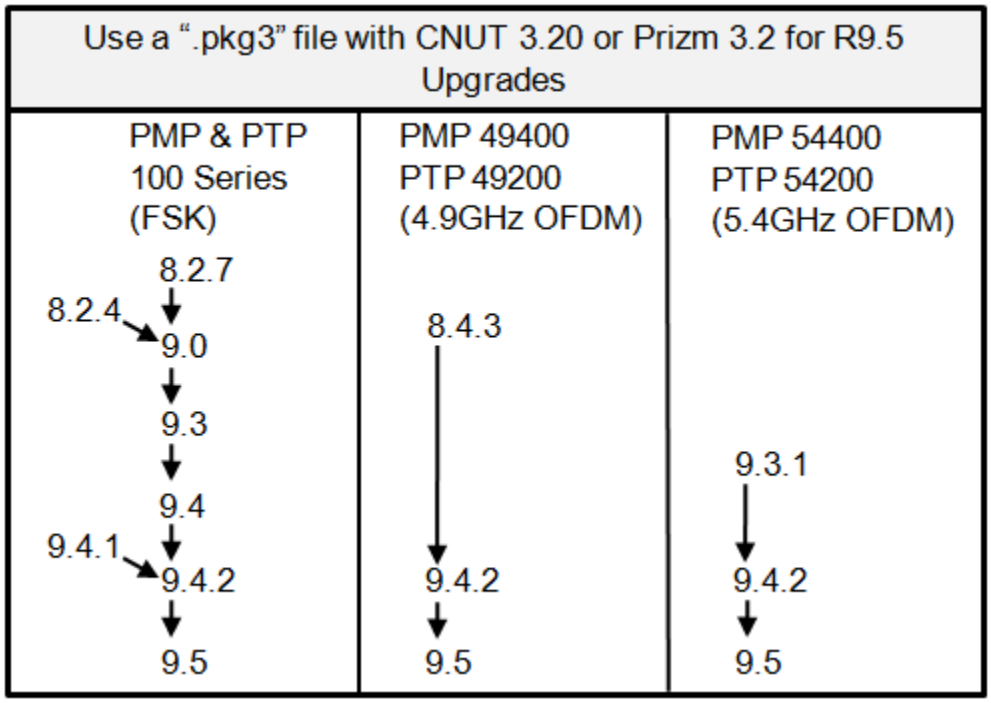


Figure 21: Upgrade path for operating sectors

Each release has new feature content and may have changes to message structures and protocols used between the AP and the SMs. These changes may affect operation of APs and SMs operating on untested mixed releases during the upgrade period, resulting in features or indicators not working properly, or in the worst case SMs being stranded by the use of untested combinations. Following the tested upgrade path is strongly recommended for operating sectors.

Standalone modules such as spares can be upgraded from any Release 8.x (or any *hardware scheduling* release) to Release 9.5. For details on upgrading modules running *software scheduling* see previous release notes, especially the Release 7.3.6 Release Notes.

7.1.3 Upgrade Tool Options

Use either CNUT 3.20 or Prizm 3.2 for the upgrade.

CNUT

CNUT (Canopy Network Updater Tool) is a free tool for upgrading Canopy modules. For information and details on installing CNUT on a PC or Linux machine, download the CNUT software and help file from the Canopy tab of http://motorola.wirelessbroadbandsupport.com/software. If you need to upgrade from a previous CNUT release, ensure you back up your network file before upgrading CNUT.

CNUT 3.20 supports upgrades of P11 modules, including 2 Mbps and 4 Mbps BHs, and should be used for upgrading modules to Release 9.5. See the CNUT 3.20 release notes for additional details.

Prizm

Motorola offers Prizm as an EMS that provides monitoring and management functions, including module upgrade. Prizm 3.2 supports upgrading modules to Release 9.5.

Prizm 3.2 or later *does not* include the Hardware Scheduler Update tool, so sectors that run software scheduling must first be switched to hardware scheduling using CNUT, before using Prizm 3.2 or later to manage upgrades. For details on switching to hardware scheduling, see previous release notes, especially the release notes for Canopy Release 7.3.6.

Operators running Prizm releases earlier than Release 3.2 should upgrade to the current Prizm release, then use Prizm to upgrade their Canopy modules to Release 9.5.

Click here for information on the Motorola Prizm element management system.

Prizm documentation and installers are available for download from the Canopy tab of http://motorola.wirelessbroadbandsupport.com/software/.

.pkg3 Packages

Upgrades use package files whose name extensions are `.pkg3`. Earlier packages (`.pkg` or `.pkg2` files) *cannot* be used with CNUT Release 3.20 and Prizm Release 3.2. A key aspect of `.pkg3` packages and the tools that use them is that they support upgrading modules using module accounts other than `root` and therefore do not require a module to have an account named `root`.

7.1.4 Special Planning for European Operators using 5.4 GHz Radios

Operators with modules set to a **Region Code** of **Europe** are well-served to ensure they are not using any channels with center frequencies of 5590 to 5660 MHz inclusive (in the weather notch) before upgrading. A sector currently using 5590 to 5660 MHz inclusive will complete the upgrade successfully and existing SMs will register and function, but since these channels are not available on equipment placed on market in Europe from July 1, 2008, adding SMs or replacing SMs or APs becomes problematic.

Operators with modules set to a **Region Code** of **Europe** may need to perform channel planning and coordinated change of the transmitting channel on APs and BHMs *before* the upgrade.

7.2 OBTAINING AND PREPARING CNUT OR PRIZM

Use either CNUT Release 3.20 or later or Prizm Release 3.2 or later for the upgrade.

7.2.1 Obtaining and Preparing CNUT

1. From the Canopy tab of http://motorola.wirelessbroadbandsupport.com/software, download

- Network Updater Tool Release 3.20 for Windows

  or
- Network Updater Tool Release 3.20 for Linux
- Network Updater Tool Release 3.20 Release Notes

2. Install CNUT Release 3.20 on Windows or Linux using the CNUT release notes.
3. If you do not have a previously stored network archive file within CNUT, add your Canopy infrastructure elements (APs, BHs, and CMMs) to the network root and Move and Modify the elements until you have captured your network.

IMPORTANT! Pay particular attention to the connectivity that you establish in the network tree. This should be the connectivity as viewed at the point from where you connect to the network to perform the upgrade. If you are connecting at your POP, this will be the same as your network hierarchy. If you are connecting at some point other than your POP, it should reflect connectivity from that point. When CNUT discovers the network and when it steps through the infrastructure elements during an upgrade, it relies on the connectivity information you enter in the network tree.

7.2.2 Obtaining and Preparing Prizm

1. Download Prizm 3.2 and Prizm 3.2 Release Notes.
2. From the Canopy tab of http://motorola.wirelessbroadbandsupport.com/software, download
   - Prizm 3.2 and Prizm 3.2 Patch 2
   - Prizm 3.2 Release Notes.
3. Install Prizm 3.2 Patch 2 using the Patch Release Notes.
4. If you do not have a previously stored network archive file within Prizm, add your Canopy infrastructure elements (APs, BHs, and CMMs) to the network root and Move and Modify the elements until you have captured your network.

7.3 OBTAINING UPGRADE PACKAGES

To download the Canopy software to your computer, perform the following steps:

1. Go to http://motorola.wirelessbroadbandsupport.com/software.
2. Follow the directions on that page to access the software download page.
3. On the software download page, select the appropriate package or packages. Options include
   - Release 9.5 FSK Software - DES
   - Release 9.5 FSK Software - AES
   - Release 9.5 OFDM Software - DES
   - Release 9.5 OFDM Software - AES

   PMP 100 and PTP 100 series (Canopy FSK radios) use the FSK software.

   PMP 49400 and 54400 radios (4.9 GHz and 5.4 GHz) use the OFDM software.

   PTP 49200 and 54200 radios (4.9 GHz and 5.4 GHz) use the OFDM software.
4. Click **Accept User Agreement and Request Download Links**.
   RESULT: You will receive an email with a link or links to the software.

5. In the email sent to you, click on the desired link or links.
   RESULT: The appropriate `.pkg3` package or packages will download to your computer.

7.4 PERFORMING THE UPGRADE VIA CNUT OR PRIZM

Upgrade using the following steps. For additional details on using CNUT, see the CNUT help file or click on the Help menu in the CNUT application. For additional details on using Prizm, see the Prizm user guide. The CNUT help file and Prizm user guide are available for download from the Canopy tab of http://motorola.wirelessbroadbandsupport.com/software.

1. Enter the password(s) for the `root` login accounts of all modules you are upgrading into CNUT or Prizm. If taking advantage of the ability to use accounts other than `root`, enter the accounts and passwords.
2. Refresh/Discover Entire Network to auto-detect all of your SMs and to display information about your network elements.
3. Add the appropriate .pkg3 file(s) to the managed packages list. Depending on the package downloaded in section 7.3, Obtaining Upgrade Packages, you will have one or more of the following .pkg3 files:
   - CANOPY95BUILDOFFICIAL_DES.pkg3
   - CANOPY95BUILDOFFICIAL_AES.pkg3
   - CANOPY95BUILDOFFICIAL_OFDM_DES.pkg3
   - CANOPY95BUILDOFFICIAL_OFDM_AES.pkg3
4. Confirm that modules operating in the United States or its territories have the **Region Code** on the Configuration => General page set to **United States.**
5. Confirm that P10 or P11 ***FSK*** 5.4-GHz APs or BHMs with a **Region Code** of **United States** are ***not*** configured with **Radio Frequency Carrier**, **Alternate Frequency Carrier 1,** or **Alternate Frequency Carrier 2** of 5590 through 5660 MHz, as these frequencies are not available after upgrading to Release 9.5.
6. Confirm that P10 or P11 ***FSK*** 5.4-GHz SMs or BHSs with a **Region Code** of **United States** are configured with center channels on the **Custom Radio Frequency Scan Selection List** outside of 5590 through 5660 MHz.
7. Confirm that ***OFDM*** 5.4-GHz APs or BHMs with a **Region Code** of **United States** are ***not*** configured with **Radio Frequency Carrier**, **Alternate Frequency Carrier 1,** or **Alternate Frequency Carrier 2** of 5600 through 5650 MHz, as these frequencies are not available after upgrading to Release 9.5.
8. Confirm that ***OFDM*** 5.4-GHz SMs or BHSs with a **Region Code** of **United States** are configured with center channels on the **Custom Radio Frequency Scan Selection List** outside of 5600 through 5650 MHz.
9. Consider rebooting APs on sectors you plan to update to eliminate any memory fragmentation issues and ensure there is space to hold the new image.
10. Just before doing any updates, use Refresh/Discover to confirm that all SMs are active.
11. Choose the elements that you want to update at this time: a selection of elements, a network branch, or the entire network. Most operators gain experience by upgrading a portion of their network at a time, depending on network size and their own procedures.
12. Use Prizm or CNUT to confirm use of SM Auto-update, as appropriate. With SM Auto-update, SMs are updated by their AP instead of by CNUT, which significantly reduces the time needed for updating an entire network. In addition, SM Auto-update must be used to update any SMs that have their **Network Accessibility** parameter set to **Local**, as these SMs are not addressable by CNUT or Prizm over the network.

13. Initiate the Update operation.
14. Monitor the update progress through the Network Tree.
15. Allow the update to run, leaving CNUT/Prizm active, until all involved SMs are upgraded. An AP enabled for Auto-update
    a. updates all registered or registering P7/8/9 SMs that require an upgrade.
    b. waits for 20 minutes of no upgrade or new P7/8/9 registration activity.
    c. updates all registered or registering P10 SMs that require an upgrade.
    d. waits for 20 minutes of no upgrade or new P10 registration activity.
    e. updates all registered or registering P11 SMs that require an upgrade.
    f. waits for 20 minutes of no upgrade or new P11 registration activity.
    g. continues this cycle until Auto-update is disabled (using CNUT or Prizm) or until the AP is rebooted.

    With this algorithm, any SMs that are not properly upgraded are found by CNUT or Prizm on a subsequent cycle and then successfully upgraded, without operator action.

    There will be quiet times during a sector upgrade due to the 20-minute inactivity timer, followed by active updating of SMs.

    With CNUT 3.20 or Prizm 3.2, the operator can choose the update order among P7/P8/P9 SMs, P10 SMs, and P11 SMs by setting the SM Autoupdate Configuration. For example, sectors with no P7/8/9 SMs should be set to upgrade P10 SMs first and not upgrade P7/P8/P9 SMs to avoid a 20 minute wait until upgrade of P10 SMs begins.
16. After the upgrade appears to have completed, Refresh/Discover.
17. Verify that the Software Version for each module is shown as `CANOPY 9.5`.
18. If any SM completed the software loading and then failed to reboot, or did reboot but CNUT or Prizm displayed a message such as “Reboot failed” or “Failed to find Element in update. Cannot open new telnet connection to device”, and if the rest of the sector successfully upgraded and became stable on Release 9.5, perform the following steps:
    a. Refresh/Discover.
    b. Check whether the resulting elements list shows the SM as operating on the new release.
    c. If it does not, reboot the problem SM.
    d. Check whether the SM is shown as operating on Release 9.5.
    e. If it is not, re-initiate the upgrade of the SM using CNUT or Prizm.
19. Disable SM Auto-update on CNUT or Prizm, according to CNUT help file or Prizm documentation.

7.4.1 Setting the Region Code

After a sector or link or standalone module has been upgraded to Release 9.5, confirm that the **Region Code** on each module is set to the local region. If needed, set the **Region Code** and associated parameters correctly on each module, **Save Changes**, and **Reboot**.

On new APs or BHMs, or APs or BHMs that have been reset to factory defaults, the Region Code must be set before the module will transmit.

8 Collocation

8.1 COLLOCATING 5.2-GHz AND 5.4-GHz MODULES

5.4-GHz radios that are set to a center channel frequency of 5595 MHz or lower produce a signal that is 280 MHz below their center channel. This signal can interfere with 5.2-GHz channels as shown In Table 12. Because of this, care needs to be taken in choosing 5.4-GHz channels where 5.4 GHz systems are collocated with 5.2-GHz systems.

Choosing 5.4-GHz channels of 5495 through 5540 MHz or 5600 through 5705 MHz avoids this collocation issue and is often the best option. Alternatively, provide 100 ft (30 m) of vertical separation between the 5.2-GHz and the 5.4-GHz radios, or in cases of partial clusters of 5.2-GHz radios, select 5.4-GHz channels that will not interfere.

Table 12: 5.4- and 5.2-GHz interfering frequencies

This 5.4-GHz center channel (in MHz)…	may interfere with these 5.2-GHz channels (in MHz)
5545	5275
5550	5275, 5280
5555	5275, 5280, 5285
5560	5275, 5280, 5285, 5290
5565	5275, 5280, 5285, 5290, 5295
5570	5280, 5285, 5290, 5295, 5300
5575	5285, 5290, 5295, 5300, 5305
5580	5290, 5295, 5300, 5305, 5310
5585	5295, 5300, 5305, 5310, 5315
5590	5300, 5305, 5310, 5315, 5320
5595	5305, 5310, 5315, 5320, 5325

Background

What causes this collocation issue? As part of their radio operation, Canopy radios produce a low level signal outside of their frequency band. By design, this signal is above the band for some center channel frequencies and below the band for other center channel frequencies. This signal is present at all times (both during transmit and receive), and is well within regulatory requirements for out-of-band emissions. However, it is strong enough to interfere with a closely collocated Canopy radio in another band, if that radio is using a channel impinged upon by the out of band signal, as can happen between 5.4- and 5.2-GHz radios.

If a CMM provides sync and ensures compatible receive start times (as advised in Collocating Same-Frequency Band Modules *on Page 53**), aren't collocation issues avoided?* No. Using sync and ensuring compatible receive start times are necessary to avoid *other* collocation issues, but do not help *this* collocation issue, because the interfering signal is present at all times, during transmit and receive.

8.2 COLLOCATING 5.4-GHz AND 5.7-GHz MODULES

For collocation design, the 5.4-GHz and 5.7-GHz frequency bands are essentially one continuous band. When collocating 5.4-GHz and 5.7-GHz modules, use the guidelines for collocating modules within a band listed under Collocating Same-Frequency Band Modules on Page 53.

Alternatively, either

- provide 100 ft (30 m) of vertical separation between the 5.4-GHz and 5.7-GHz radios.
- if 100 ft (30 m) of vertical separation is not possible, provide as much vertical separation as possible, and choose frequencies far apart within the combined
  5.4-GHz and 5.7-GHz bands. The physical and spectral separation and local RF conditions, influenced by tower geometries, layout and position of modules, and use of reflectors on BHs, among other variables, may support good performance, but testing and monitoring will be required to confirm that they do.

For example, when collocating a cluster of six 5.4-GHz APs with a cluster of six 5.7-GHz APs, all hardware scheduled, set them all to the same range, downlink data %, and control slots, and use standard frequency re-use around each cluster (ABCABC).

For another example, when collocating a cluster of six 5.4-GHz APs with a 5.7-GHz BH that is retrofitted with a reflector, provide 100 vertical feet of separation. If this is not possible

1. choose channels for the AP that are at the bottom of the 5.4-GHz band.
2. choose a channel for the BH that is at the top of the 5.7-GHz band.
3. locate the modules so the reflector on the BH shields the APs from the BH module.
4. ensure the over-illumination around the edges of the reflector is not directed at the APs.
5. confirm with simultaneous link tests.

Background

Why are 5.4-GHz and 5.7-GHz bands considered one band for Canopy collocation, whereas other bands (say 5.2-GHz and 5.7-GHz) are considered separate? 5.4-GHz and 5.7-GHz radios use the same radio front end, whereas 5.2-GHz and 5.7-GHz Canopy modules have different radio front ends. For collocation design, the 5.4-GHz and 5.7-GHz bands are essentially one continuous band, albeit one with possibilities for large spectral separation of channels.

8.3 COLLOCATING SAME-FREQUENCY BAND MODULES

Canopy can avoid self-interference if collocated modules in the same frequency band are of the same type, start each frame transmission at the same time, and start each frame reception at the same time. If you collocate radios of the same frequency band, do the following also:

- Within the same band, collocate only one type of module (only APs, only BHMs, or only BHSs).
- Use a CMM, so that transmit start times are in sync.
- Use identical scheduler type (hardware or software)
- Either

- Set identical range, downlink data %, and slot settings
- Use the Frame Calculator (see Using the Frame Calculator below) to ensure compatible receive start times.

This ensures that at any one instant the collocated modules are either all receiving or all transmitting. This avoids, for example, the issue of one AP attempting to receive a signal from a distant SM, while a nearby AP is transmitting and overpowering the signal from the distant SM.

8.3.1 Using the Frame Calculator

Parameters that affect receive start times include range, slots, downlink data percentage, and high priority uplink percentage (with software scheduling only). A frame calculator is included in every module as a helper application to help calculate compatible settings. The frame calculator does not itself configure or change any settings on the module.

The frame calculator in a module can be used to perform all frame calculations. The operator enters settings into the calculator, and the calculator outputs details on the frame including an **Uplink Rcv SQ Start** value. This calculation should be done for each AP that has different settings. Then the operator varies the **Downlink Data** % in each calculation until the calculated values of **Uplink Rcv SQ Start** for all collocated APs are within 150 time bits.

For more details on using the frame calculator, refer to the Canopy Release 8 User Guide, available at http://motorola.wirelessbroadbandsupport.com/software.

8.3.2 Establishing Vertical Separation

If you do not use the Frame Calculator

- provide 100 ft (30 m) of vertical separation between same-band modules.
- if 100 ft (30 m) of vertical separation is not possible, alternatively provide as much vertical separation as possible, and choose frequencies far apart within the band. The physical and spectral separation and local RF conditions (influenced by tower geometries, layout and position of modules, and use of reflectors on BHs, among other variables) may support good performance, but testing and monitoring will be required to confirm that they do.

A system that is under no load with SMs registered and is able to communicate indicates basic connectivity, but does not indicate that the system will function well under heavy load. The more conservatively you design collocation, the less you will see interference issues, which may be hidden under light loads, but cause problems when the system becomes heavily loaded.

9 Performance Benchmarking Process

9.1.1 Definitions

The following terms are used where these release notes discuss packet processing:

Aggregate Throughput	Sum of uplink plus downlink traffic.
Offered Load	Test equipment generates a specified load to the Ethernet interface of a module (SM or the AP). The specifications of the load include both packet size and packet rate.
Carried Load	Test equipment measures the load delivered at the Ethernet interface of a module. The load is calculated from packet size and number of packets. As resources are exhausted at any point in the system, packets may be dropped. The Carried Load equals the Offered Load minus Dropped Packets.
Downlink/Uplink Load Ratio	The ratio of downlink Carried Load to uplink Carried Load. *NOTE: Do not* confuse the Downlink/Uplink Load Ratio with the **Downlink Data** configuration parameter. The Downlink/Uplink Load Ratio is determined from the Carried Loads. The **Downlink Data** is set by the operator and determines the split of downlink and uplink slots in the air frame.

9.1.2 System Performance and System Constraints

In any complex system like Canopy there are multiple performance constraints. Different combinations of system inputs will result in different constraints limiting system performance.

Larger Packets

With larger packets (Canopy handles packets up to 1522 Bytes), the system constraint is *airtime*, which can also be stated as *slots*, or maximum bits per second. This can be calculated as follows:

64 Bytes/fragment x 2 fragments/slot x 34 slots/frame x 400 frames/sec x 8 bits/byte = 14 Mbps

This is an aggregate (uplink plus downlink) limit, as the Canopy system is a Time Division Duplex (TDD) system.

14 Mbps is a typical maximum aggregate throughput for larger packet sizes for an FSK system. Longer range settings can reduce the number of slots in a frame and packet size (breakage on 64-byte boundaries) can affect packing efficiency (the percentage of fragments fully packed with 64 bytes).

Smaller Packets

With smaller packets, the system constraint is *processing power* in any module handling the traffic stream. Even though there may be airtime or slots available, the overall throughput is limited by packet handling ability.

9.1.3 Benchmark Definition

In a complex system, any measurement depends on system configuration, traffic mix, various settings, and measurement techniques, and so to have reproducible results a “benchmark” is defined.

System configuration

The PMP benchmark system consists of 3 SMs and 1 Advantage AP, as shown in Figure 22 on page 57. Traffic generation and measurement equipment is connected to both SMs and the AP. Traffic is generated such that any one packet attempts to traverse an SM and then the AP, or the AP and then an SM. No SM-to-SM traffic is included in the benchmark. RF conditions are maintained such that all links run at max rate (2X or 3X).

The PTP benchmark system consists of 1 BHM and 1 BHS, with traffic generation and measurement equipment connected to both BHs.

Traffic mix/Packet size

All generated packets have a size of 64 Bytes. The packet format used is a valid Ethernet/IP packet. The performance of interest is performance near a 50% Downlink/Uplink Load Ratio.

PMP Settings

- Downlink Data: 50%
- Control Slots: 2
- Range: 2 miles
- Max rate (2X or 3X) Enabled
- Encryption: Enabled (DES modules)
- MIR: 20,000 kbits/sec sustained rate and 500,000 kbits burst allocation (defaults)
- CIR: 0 (default)
- NAT: Disabled (default)
- VLAN: Disabled (default)
- High Priority: Disabled (default)

PTP Settings

- Downlink Data: 50%
- Max rate (2X or 3X) Enabled
- Encryption: Enabled (DES modules)

Measurement technique

1. Send a specific number of frames at a specific rate through SMs and AP (uplinks) and AP and SM (downlink) simultaneously. This is the Offered Load. Count the frames that are received correctly at both sides. This is the Carried Load. Repeat this through the load rates of interest. Review the results, noting where the packet loss (the difference between the Offered Load and Carried Load) is essentially zero (<0.001%).
2. Confirm results by running longer tests at selected load rates.

3. Confirm results by varying Downlink/Uplink Load Ratios to ensure no significant changes around the 50% benchmark.

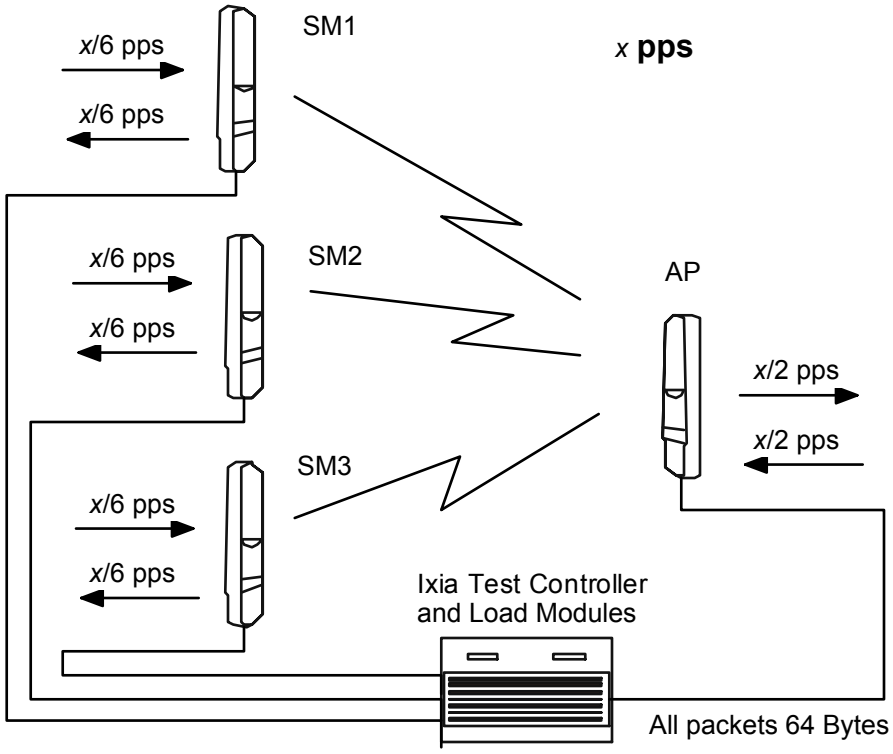


Figure 22: Benchmark test setup

10 Regulatory and Legal Notices

10.1 IMPORTANT NOTE ON MODIFICATIONS

Intentional or unintentional changes or modifications to the equipment must not be made unless under the express consent of the party responsible for compliance. Any such modifications could void the user's authority to operate the equipment and will void the manufacturer's warranty.

10.2 NATIONAL AND REGIONAL REGULATORY NOTICES

10.2.1 U.S. Federal Communication Commission (FCC) Notification

For 900-MHz, 2.4-GHz, 5.2-GHz. 5.4-GHz, and 5.7-GHz devices:

This device complies with Part 15 of the US FCC Rules and Regulations. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

FCC IDs and the specific configurations covered are listed in Table 13.

For 4.9-GHz devices:

The 4.9-GHz band is a licensed band allocated to public safety services. State and local government entities that provide public safety services are eligible to apply for 4.9 GHz licenses. For additional information, refer to FCC regulations.

Table 13: US FCC IDs and Industry Canada Certification Numbers and covered configurations

FCC ID	Industry Canada Cert Number	Frequencies	Module Families	Antenna, Reflector, or Lens[1]	Maximum Transmitter Output Power[1]
ABZ89FC5809	109W-9000	8 MHz channels, centered on 906-924 MHz in 1 MHz increments (within the 902-928 MHz ISM band)	9000 SM, AP	12 dBi integrated antenna	24 dBm (250 mW)
				17 dBi Last Mile Gear Cyclone 900-17H Yagi	18 dBm (63 mW)
				10 dBi Maxrad Model # Z1681 (MP9027XFPT or Motorola AN900A) flat panel	26 dBm (390 mW)
				10 dBi Mars Model # MA-IS91-T2, flat panel	26 dBm (390 mW)
				10 dBi MTI Model # MT-2630003/N (MT-263003/N) flat panel	26 dBm (390 mW)
				8 dBi integrated antenna (Indoor SM)	26 dBm (390 mW)
ABZ89FC5808	109W-2400	20 MHz channels, centered on 2415-2457.5 MHz in 2.5 MHz increments (within the 2400-2483.5 MHz ISM band)	2400 BH, SM, AP	8 dBi internal	25 dBm (340 mW)
			2400 BH, SM	8 dBi internal + 11 dB reflector	25 dBm (340 mW)
ABZ89FC3789	109W-5200	20 MHz channels, centered on 5275-5325 MHz in 5 MHz increments (within the 5250-5350 MHz U-NII band)	5200 BH, SM, AP P7/8/9	7 dBi internal	23 dBm (200 mW)
			5200 BH SM, AP P10/11	7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dB lens	14 dBm (25 mW)
ABZ89FC5807 for P7/8/9 ABZ89FC3789 for P10/11	109W-5210 for P78/9 109W-5200 for P10/11	20 MHz channels, centered on 5275-5325 MHz in 5 MHz increments (within the 5250-5350 MHz U-NII band)	5210 BH	7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)

FCC ID	Industry Canada Cert Number	Frequencies	Module Families	Antenna, Reflector, or Lens[1]	Maximum Transmitter Output Power[1]
ABZ89FT7623	---	20 MHz channels, centered on 5495-5705 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band)	5400 BH, SM, AP	7 dBi internal	23 dBm (200 mW)
				7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dB lens	14 dBm (25 mW)
---	109W-5400	20 MHz channels, centered on 5495-5585 and 5665-5705 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band with 5600-5650 MHz excluded)	5400 BH, SM, AP	7 dBi internal	23 dBm (200 mW)
				7 dBi internal + 18 dB reflector	5 dBm (3.2 mW)
				7 dBi internal + 9 dB lens	14 dBm (25 mW)
ABZ89FC5804	109W-5700	20 MHz channels, centered on 5735-5840 MHz in 5 MHz increments (within the 5725-5850 MHz ISM band)	5700 BH, SM, AP	7 dBi internal	23 dBm (200 mW)
			5700 BH, SM	7 dBi internal + 18 dB reflector	23 dBm (200 mW)
				7 dBi internal + 10 dB lens	23 dBm (200 mW)
			5700 AP	7 dBi internal + 10 dB lens	19 dBm (80 mW)
ABZ89FT7629	---	10 MHz channels, centered on 5480-5710 in 5 MHz increments (within the 5470-5725 MHz U-NII band)	5440 AP	18 dBi connectorized PCTEL Model **8514724E01** antenna (60° x 5° -3 dB beam width) with 1 dB connector cable loss	10 dBm
			5440 SM 5440 BH	17 dBi integrated antenna (15° x 15° -3 dB beam width)	10 dBm
---	109W-5440	10 MHz channels, centered on 5480-5595 and 5655-5710 MHz in 5 MHz increments (within the 5470-5725 MHz U-NII band with 5600-5650 MHz excluded)	5440 AP	18 dBi connectorized PCTEL Model **8514724E01** antenna (60° x 5° -3 dB beam width) with 1 dB connector cable loss	10 dBm

			5440 SM 5440 BH	17 dBi integrated antenna (15° x 15° -3 dB beam width)	10 dBm
ABZ89FT7631	109W-4940	10 MHz channels, centered on 4945-4985 in 5 MHz increments (within the 4940-4990 MHz public safety licensed band)	4940 AP	18 dBi connectorized PCTEL Model **AP 85010066001** antenna (60° x 5° -3 dB beam width) with 1 dB cable loss	18 dBm
			4940 SM 4940 BH	17 dBi integrated antenna (15.5° x 17.5° (el x az) -3 dB beam width)	18 dBm
Note 1: To ensure regulatory compliance, including DFS compliance, the professional installer is responsible for ◦ setting the Region Code on the Configuration => General page to the correct region ◦ setting the Transmitter Output Power on the Confiiguration => Radio page no higher than listed for a given configuration setting the External Gain on the Configuration => Radio page, if displayed, to the gain of any external device (such as a reflector or lens)					

10.2.2 Industry Canada (IC) Notification

For 900-MHz, 2.4-GHz, 5.2-GHz. 5.4-GHz, and 5.7-GHz devices:

This device complies with RSS-210 of Industry Canada. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Users should be cautioned to take note that in Canada high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5650 – 5850 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to RSS-210 of Industry Canada. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

To reduce potential radio interference to other users, the antenna type and its gain should be chosen so its Equivalent Isotropic Radiated Power (EIRP) is not more than that permitted for successful communication.

Industry Canada Certification Numbers and the specific configurations covered are listed in Table 13.

This device has been designed to operate with the antennas listed in Table 13 and having a maximum gain as shown in Table 13. Antennas not included or having a gain greater than as shown in Table 13 are strictly prohibited from use with this device. Required antenna impedance is 50 ohms.

For 4.9-GHz devices:

The 4.9-GHz band is a licensed band allocated to public safety services. Government entities that provide public safety services are eligible to apply for 4.9 GHz licenses. For additional information, refer to Industry Canada regulations.

10.2.3 Regulatory Requirements for CEPT Member States (www.cept.org)

When operated in accordance with the instructions for use, Motorola Canopy Wireless equipment operating in the 2.4 and 5.4 GHz bands is compliant with CEPT Recommendation 70-03 Annex 3 for Wideband Data Transmission and HIPERLANs. For compliant operation in the 2.4 GHz band, the transmit power (EIRP) from the built-in patch antenna and any associated reflector dish shall be no more than 100mW (20dBm). For compliant operation in the 5.4 GHz band, the transmit power (EIRP) from the built-in patch antenna and any associated reflector dish shall be no more than 1 W (30 dBm).

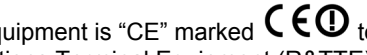
The following countries have completely implemented CEPT Recommendation 70-03 Annex 3A (2.4 GHz band):

- EU & EFTA countries: Austria, Belgium, Denmark, Spain, Finland, Germany, Greece, Iceland, Italy, Ireland, Liechtenstein, Luxembourg, Netherlands, Norway, Portugal, Switzerland, Sweden, UK
- New EU member states: Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovenia, Slovakia
- Other non-EU & EFTA countries: Bosnia and Herzegovina, Turkey

The following countries have a limited implementation of CEPT Recommendation 70-03 Annex 3A:

- France – Outdoor operation at 100mW is only permitted in the frequency band 2400 to 2454 MHz;
  - Any outdoor operation in the band 2454 to 2483.5MHz shall not exceed 10mW (10dBm);
  - Indoor operation at 100mW (20dBm) is permitted across the band 2400 to 2483.5 MHz
- French Overseas Territories:
  - Guadeloupe, Martinique, St Pierre et Miquelon, Mayotte – 100mW indoor & outdoor is allowed
  - Réunion and Guyana – 100mW indoor, no operation outdoor in the band 2400 to 2420MHz
- Italy – If used outside own premises, general authorization required
- Luxembourg - General authorization required for public service
- Romania – Individual license required. T/R 22-06 not implemented

Motorola Canopy Radios operating in the 2400 to 2483.5MHz band are categorized as “Class 2” devices within the EU and are marked with the class identifier symbol  , denoting that national restrictions apply (for example, France). The French restriction in the 2.4 GHz band will be removed in 2011.

This 2.4 GHz equipment is “CE” marked  to show compliance with the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC. The relevant Declaration of Conformity can be found at http://motorola.wirelessbroadbandsupport.com/doc.php.

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. However, for CEPT member states, 2.4 GHz Wideband Data Transmission equipment has been designated exempt from individual licensing under decision ERC/DEC(01)07. For EU member states, RLAN equipment in both the 2.4 & 5.4GHz bands is exempt from individual licensing under Commission Recommendation 2003/203/EC. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply. Also see www.ero.dk for further information.

Motorola Canopy Radio equipment operating in the 5470 to 5725 MHz band are categorized as “Class 1” devices within the EU in accordance with ECC DEC(04)08 and are “CE” marked to show compliance

with the European Radio & Telecommunications Terminal Equipment (R&TTE) directive 1999/5/EC. The relevant Declaration of Conformity can be found at http://motorola.wirelessbroadbandsupport.com/doc.php.

A European Commission decision, implemented by Member States on 31 October 2005, makes the frequency band 5470-5725 MHz available in all EU Member States for wireless access systems. Under this decision, the designation of Canopy 5.4GHz products become “Class 1 devices” and these do not require notification under article 6, section 4 of the R&TTE Directive. Consequently, these 5.4GHz products are only marked with the CE symbol and may be used in any member state.

For further details, see
http://europa.eu.int/information_society/policy/radio_spectrum/ref_documents/index_en.htm

10.2.4 European Union Notification for 5.7 GHz Product

The 5.7 GHz connectorized product is a two-way radio transceiver suitable for use in Broadband Wireless Access System (WAS), Radio Local Area Network (RLAN), or Fixed Wireless Access (FWA) systems. It is a Class 2 device and uses operating frequencies that are not harmonized throughout the EU member states. The operator is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country.

This equipment is marked CE! 0977to show compliance with the European R&TTE directive 1999/5/EC.

The relevant Declaration of Conformity can be found at
http://motorola.wirelessbroadbandsupport.com/doc.php.

10.2.5 Equipment Disposal

Waste (Disposal) of Electronic and Electric Equipment

Please do not dispose of Electronic and Electric Equipment or Electronic and Electric Accessories with your household waste. In some countries or regions, collection systems have been set up to handle waste of electrical and electronic equipment. In European Union countries, please contact your local equipment supplier representative or service center for information about the waste collection system in your country.

10.2.6 EU Declaration of Conformity for RoHS Compliance

Motorola hereby, declares that these Motorola products are in compliance with the essential requirements and other relevant provisions of Directive 2002/95/EC, Restriction of the use of certain Hazardous Substances (RoHS) in electrical and electronic equipment.

The relevant Declaration of Conformity can be found at
http://motorola.wirelessbroadbandsupport.com/doc.php.

10.2.7 UK Notification

The 5.7 GHz connectorized product has been notified for operation in the UK, and when operated in accordance with instructions for use it is compliant with UK Interface Requirement IR2007. For UK use, installations must conform to the requirements of IR2007 in terms of EIRP spectral density against elevation profile above the local horizon in order to protect Fixed Satellite Services. The frequency range 5795-5815 MHz is assigned to Road Transport & Traffic Telematics (RTTT) in the U.K. and shall not be used by FWA systems in order to protect RTTT devices. UK licensing specifies that radiolocation services shall be protected by a Dynamic Frequency Selection (DFS) mechanism to prevent co-channel operation in the presence of radar signals.

10.2.8 Belgium Notification

Belgium national restrictions in the 2.4 GHz band include

- EIRP must be lower then 100 mW
- For crossing the public domain over a distance >300m the user must have the authorization of the BIPT.
- No duplex working

10.2.9 Luxembourg Notification

For the 2.4 GHz band, point-to-point or point-to-multipoint operation is only allowed on campus areas. 5.4GHz products can only be used for mobile services.

10.2.10 Czech Republic Notification

2.4 GHz products can be operated in accordance with the Czech General License No. GL-12/R/2000.

5.4 GHz products can be operated in accordance with the Czech General License No. GL-30/R/2000.

10.2.11 Norway Notification

Use of the frequency bands 5725-5795 / 5815-5850 MHz are authorized with maximum radiated power of 4 W EIRP and maximum spectral power density of 200 mW/MHz. The radio equipment shall implement Dynamic Frequency Selection (DFS) as defined in Annex 1 of ITU-R Recommendation M.1652 / EN 301 893. Directional antennae with a gain up to 23 dBi may be used for fixed point-to-point links. The power flux density at the border between Norway and neighboring states shall not exceed – 122.5 dBW/m^2 measured with a reference bandwidth of 1 MHz.

Canopy 5.7 GHz connectorized products have been notified for use in Norway and are compliant when configured to meet the above National requirements. Users shall ensure that DFS functionality is enabled, maximum EIRP respected for a 20 MHz channel, and that channel spacings comply with the allocated frequency band to protect Road Transport and Traffic Telematics services (for example, 5735, 5755, 5775 or 5835 MHz are suitable carrier frequencies). Note that for directional fixed links, TPC is not required, conducted transmit power shall not exceed 30 dBm, and antenna gain is restricted to 23 dBi (maximum of 40W from the Canopy 5.7 GHz connectorized products).

10.2.12 Brazil Notification

Local regulations do not allow the use of 900 MHz, 2.4 GHz, or 5.2 GHz Canopy modules in Brazil.

For compliant operation of an AP in the 5.7 GHz band, the Equivalent Isotropic Radiated Power from the built-in patch antenna and any associated reflector dish or LENS shall not exceed 36 dBm (4 W). When using the passive reflector (18 dB), transmitter output power must be configured no higher than 11 dBm. When using the LENS (10 dB at 5.7 GHz), transmitter output power must be configured no higher than 19 dBm.

For compliant operation in the 5.4 GHz band, the Equivalent Isotropic Radiated Power from the built-in patch antenna and any associated reflector dish or LENS shall not exceed 30 dBm (1 W). When using the passive reflector (18 dB), transmitter output power must be configured no higher than 5 dBm. When using the LENS (9 dB at 5.4 GHz), transmitter output power must be configured no higher than 14 dBm. When not using the passive reflector or the LENS, the transmitter output power of the radio must be configured no higher than 23 dBm.

The operator is responsible for enabling the DFS feature on any Canopy 5.4 GHz radio by setting the Region Code to “Brazil”, including after the module is reset to factory defaults.

Important Note: This equipment operates as a secondary application, so it has no rights against harmful interference, even if generated by similar equipment, and cannot cause harmful interference on systems operating as primary applications.

10.2.13 Australia Notification

900 MHz modules must be set to transmit and receive only on center channels of 920, 922, or 923 MHz so as to stay within the ACMA approved band of 915 MHz to 928 MHz for the class license and not interfere with other approved users.

After taking into account antenna gain (in dBi), 900 MHz modules' transmitter output power (in dBm) must be set to stay within the legal regulatory limit of 30 dBm (1 W) EIRP for this 900 MHz frequency band.

10.2.14 Labeling and Disclosure Table for China

The People's Republic of China requires that Motorola's products comply with China Management Methods (CMM) environmental regulations. (China Management Methods refers to the regulation *Management Methods for Controlling Pollution by Electronic Information Products*.) Two items are used to demonstrate compliance; the label and the disclosure table.

The label is placed in a customer visible position on the product.

- Logo 1 means that the product contains no substances in excess of the maximum concentration value for materials identified in the China Management Methods regulation.
- Logo 2 means that the product may contain substances in excess of the maximum concentration value for materials identified in the China Management Methods regulation, and has an Environmental Friendly Use Period (EFUP) in years, fifty years in the example shown.

Logo 1  Logo 2 

The Environmental Friendly Use Period (EFUP) is the period (in years) during which the Toxic and Hazardous Substances (T&HS) contained in the Electronic Information Product (EIP) will not leak or mutate causing environmental pollution or bodily injury from the use of the EIP. The EFUP indicated by the Logo 2 label applies to a product and all its parts. Certain field-replaceable parts, such as battery modules, can have a different EFUP and are marked separately.

The Disclosure table is intended to communicate compliance with only China requirements; it is not intended to communicate compliance with EU RoHS or any other environmental requirements.

Table 14: Disclosure table

部件名称	有毒有害物质或元素					
	铅 (**Pb**)	汞 (**Hg**)	镉 (**Cd**)	六价铬 (**Cr^{6+}**)	多溴联苯 (**PBB**)	多溴二苯醚 (**PBDE**)
金属部件	×	○	×	×	○	○
电路模块	×	○	×	×	○	○
电缆及电缆组件	×	○	×	×	○	○
塑料和聚合物部件	○	○	○	○	○	×
○： 表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。						

×：	表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006 标准规定的限量要求。

10.3 RF EXPOSURE SEPARATION DISTANCES

To protect from overexposure to RF energy, install Canopy radios so as to provide and maintain the minimum separation distances from all persons shown in Table 15.

Table 15: Exposure separation distances

Module Type	Separation Distance from Persons
Canopy Module (FSK or OFDM)	At least 20 cm (approx 8 in)
Canopy Module with Reflector Dish	At least 1.5 m (approx 60 in or 5 ft)
Canopy Module with LENS	At least 0.5 m (approx 20 in)
Antenna of connectorized or integrated 900 MHz module	At least 80 cm (32 in)
Indoor 900 MHz SM	At least 10 cm (4 in)

The following section and its Table 16 provide details and discussion of the associated calculations.

10.3.1 Details of Exposure Separation Distances Calculations and Power Compliance Margins

Limits and guidelines for RF exposure come from:

- US FCC limits for the general population. See the FCC web site at http://www.fcc.gov, and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See the Health Canada web site at http://www.hc-sc.gc.ca/rpb and Safety Code 6.
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site at http://www.icnirp.de/ and *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields*.

The applicable power density exposure limits from the documents referenced above are

- 6 W/m^2 for RF energy in the 900-MHz frequency band in the US and Canada.
- 10 W/m^2 for RF energy in the 2.4-, 5.2-, 5.4-, and 5.7-GHz frequency bands.

Peak power density in the far field of a radio frequency point source is calculated as follows:

$$S = \frac{P \cdot G}{4 \pi d^2}$$

where
S = power density in W/m^2
P = RMS transmit power capability of the radio, in W
G = total Tx gain as a factor, converted from dB
d = distance from point source, in m

Rearranging terms to solve for distance yields $$d = \sqrt{\frac{P \cdot G}{4 \pi S}}$$

Table 16 shows calculated minimum separation distances d, recommended distances and resulting power compliance margins for each frequency band and antenna combination.

Table 16: Calculated exposure distances and power compliance margins

Band	Antenna	Variable			*d* (calculated)	Recommended Separation Distance	Power Compliance Margin
		P	*G*	S			
900 MHz	integrated	0.25 W (24 dBm)	15.8 (12 dB)	6 W/m^2	23 cm	80 cm (32 in)	12
	external Yagi	0.063 W (18 dBm)	50.1 (17 dB)	6 W/m^2	20 cm	80 cm (32 in)	15
	external flat panel	0.39 W (26 dBm)	10.0 (10 dB)	6 W/m^2	23 cm	80 cm (32 in)	12
	indoor, integrated	Simulation model used to estimate Specific Absorption Rate (SAR) levels				10 cm (4 in)	2
2.4 GHz	integrated	0.34 W (25 dBm)	6.3 (8 dB)	10 W/m^2	13 cm	20 cm (8 in)	2.3
	integrated plus reflector	0.34 W (25 dBm)	79.4 (19 dB)	10 W/m^2	46 cm	1.5 m (5 ft)	10
5.2 GHz	integrated	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	9 cm	20 cm (8 in)	5
	integrated plus reflector	0.0032 W (5 dBm)	316 (25 dB)	10 W/m^2	9 cm	1.5 m (5 ft)	279
	integrated plus LENS	0.025 W (14 dBm)	40 (16 dB)	10 W/m^2	9 cm	50 cm (12 in)	31
5.4 GHz	integrated	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	9 cm	20 cm (8 in)	5
	integrated plus reflector	0.0032 W (5 dBm)	316 (25 dB)	10 W/m^2	9 cm	1.5 m (5 ft)	279
	integrated plus LENS	0.020 W (13 dBm)	50 (17 dB)	10 W/m^2	9 cm	50 cm (12 in)	31

Band	Antenna	Variable			*d* (calculated)	Recommended Separation Distance	Power Compliance Margin
		P	***G***	**S**			
5.7 GHz	integrated	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	9 cm	20 cm (8 in)	5
	integrated plus reflector	0.2 W (23 dBm)	316 (25 dB)	10 W/m^2	71 cm	1.5 m (5 ft)	4.5
	Integrated plus LENS	0.2 W (23 dBm)	50 (17 dB)	1 W/m^2	28 cm	50 cm (12 in)	3.13
5.4 GHz OFDM	Integrated, 17 dBi	0.05 W (10 dBm)	50 (17 dB)	10 W/m^2	6 cm	20 cm (8 in)	10
	Connectorized, 17 dBi	0.05 W (10 dBm)	50 (17 dB)	10 W/m^2	6 cm	20 cm (8 in)	10
4.9 GHz OFDM	Integrated, 17 dBi	0.063 W (18 dBm)	40 (16 dB)	10 W/m^2	14 cm	20 cm (8 in)	2
	Connectorized, 17 dBi	0.063 W (18 dBm)	40 (16 dB)	10 W/m^2	14 cm	20 cm (8 in)	2

The Recommended Separation Distance is chosen to give significant compliance margin in all cases. It is also chosen so that a given item (bare module, reflector, or LENS) always has the same distance, regardless of frequency band, to simplify remembering and following exposure distances in the field.

These are conservative distances:

- They are along the beam direction (the direction of greatest energy). Exposure to the sides and back of the module is significantly less.
- They meet sustained exposure limits for the general population (not just short-term occupational exposure limits), with considerable margin.
- In the reflector cases, the calculated compliance distance *d* is greatly overestimated because the far-field equation models the reflector as a point source and neglects the physical dimension of the reflector.

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